THE FOUNDRY

Volume 53
Number 10

CLEVELAND, OHIO, MAY 15, 1925

Published
Semimonthly

Castings Uphold the Student While Gaining Knowledge

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Cast Parts Are Used in Various Types of Desks

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Find Where Castings Can Be Sold

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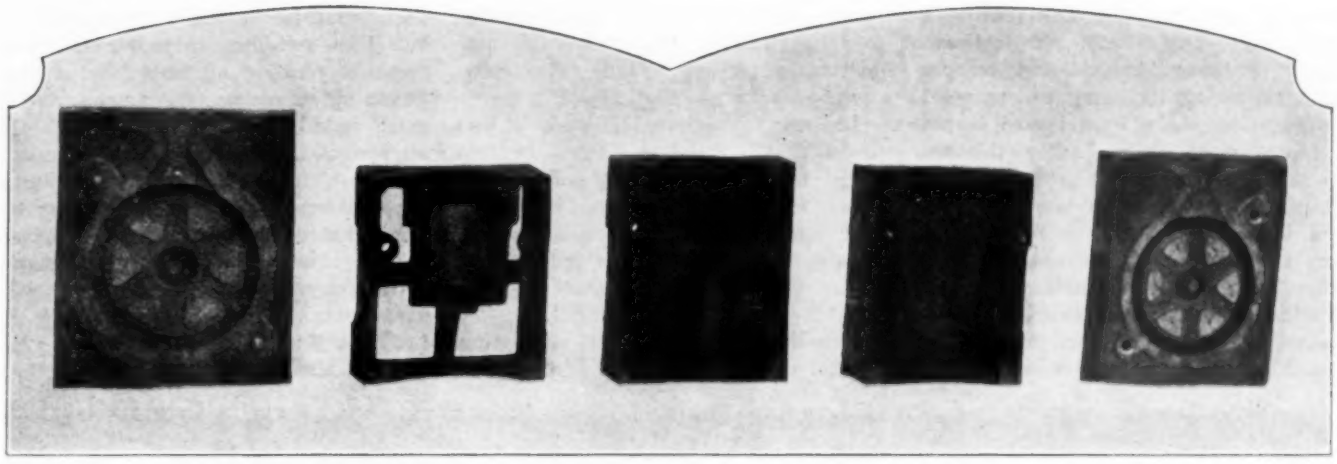


Fig. 1—Molds for Making Gear Blanks and Plow Points and Half of Piston Mold

Makes Castings Continuously *in Permanent Molds*

Company Develops Method of Impregnating Cast Iron Molds with Zinc —Applys Process to Various Types of Ferrous and Nonferrous Castings

OF ALL the great modern inventions, the automobile approaches most nearly the ideal of universal service. It is used for business and pleasure in the great city and the most remote farm or ranch. It has shortened time and distance and has bound the entire country into one great unit. The automobile carries the worker home from his shop or office after the day of labor and then takes the family into the country.

While the automobile was being developed, it brought new problems to many established lines of manufacture and induced speed and perfection in age-old processes. The engineer was called upon to produce better machines and methods for making the various component parts of the automobile. To the foundrymen was given the task of supplying better castings, of making them cheaper and in much less time. To accomplish this task, he in turn placed greater demands upon the manufacturer of equipment. Thus in approaching its present state, the automobile has induced unprecedented progress in widely diverse lines.

For years foundrymen have dreamed of iron castings produced in permanent molds. The development of the automobile has crystallized ideas along these lines. Imperative demand for repetition castings has made the permanent mold even more essential.

In 1919, Hubert A. Myers thought, like many others before him, that he could devise a process for making cast iron castings in permanent molds. He interested a group of prominent men in Toledo, O., including Gordon Mather, Henry Thompson, W. W. Knight, and Harold Reynolds, in financing a company to develop the proposition on a commercial scale. The work proceeded for several years, a great amount of effort and a large sum of money being expended in experiments. During this time a number of castings were produced, including various parts for automobiles and scales. After spending in the neighborhood of $150,000 and not producing a process which appeared successful commercially, the matter was allowed to lie dormant.

During the war, H. S. Lee, a practical foundryman, was connected with an organization making engines for airplanes. Much experimental work was done on making pistons in per-

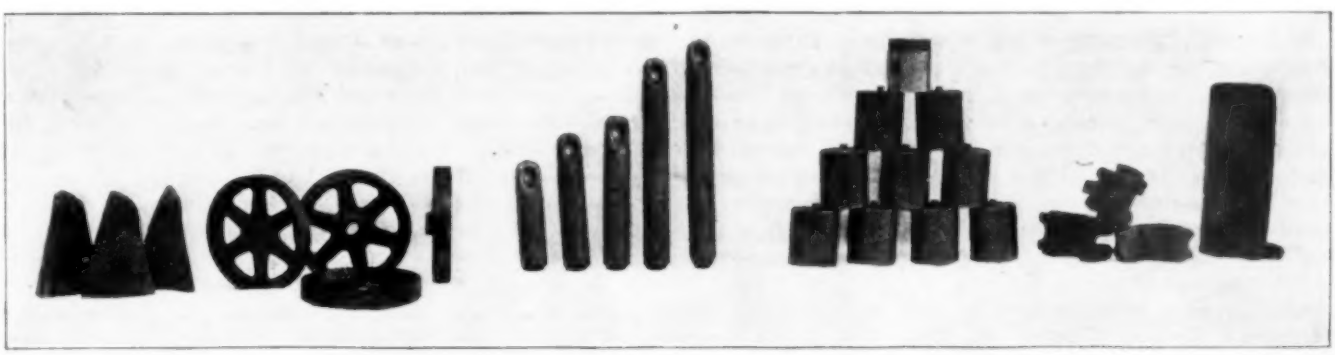


FIG. 2—THE PROCESS MAY BE APPLIED TO MAKING VARIOUS CASTINGS. PLOW POINTS, GEAR BLANKS, SASHWEIGHTS, PISTONS, BEARINGS AND A SLEEVE MADE AT THE LEE FOUNDRY

manent molds, and Mr. Lee became interested in this study. He collected much of the published work on permanent molds, including the principal patents that have been issued in this country since 1861. After the war he decided to develop a process for making castings in permanent molds, his first attempts being confined entirely to pistons. He established a plant at Plymouth, Mich., where he conducted many experiments and reached some definite conclusions, which he soon discovered were identical to those of the Toledo organization.

However, during this period the Toledo group was reorganized. Much further experimental work had been done toward developing a successful process for making ferrous and nonferrous castings in permanent molds, and some definite principles had been developed. It was natural the Toledo company and Mr. Lee should combine their ideas and experience. This combination was effected some time ago, and the original Toledo company, which was called The Hubert A. Myers Co., has been changed to the Permanent Mold & Casting Machine Co. It is the intention of this company to market casting machines, molds, and complete technical service to foundries for the commercial production of ferrous and nonferrous castings in permanent molds.

In early experimental work it was found that pouring hot iron in cold metal molds resulted in chilled castings. On the other hand, if molten iron was poured in hot metal molds, ultimate sticking or welding resulted, unless the mold was treated in some way to prevent this action.

Mr. Myers presented the idea that a mold containing nickel or chromium would be successful, as the castings were poured from metal melting at a lower temperature than these comparatively rare and higher grade materials. This did not prove to be the case, however, and later some of his associates working along similar lines suggested the treating of cast iron mold surfaces so that the molten iron would not stick to it even when the molds were red hot. The theory of this treatment is to impregnate the mold with a metal which gasifies at lower temperatures than molten cast iron, and thus a thin layer of gas separates the casting from the mold. Most of the experimental work on this theory was done by N. E. Hendrickson of the Mather Spring Co., Toledo, Ohio, who, by numerous tests, worked out the metallurgical details and found a number of materials of low gasifying temperature, among them, zinc, cadmium, magnesium, etc. Of all the materials zinc is the cheapest and best, for it has a great affinity for cast iron, and consequently may be impregnated to considerable depths.

This idea of gasification proved satisfactory in practice, and is being used today at the plant of the H. S. Lee Foundry & Machine Co., at Plymouth, Mich. This company makes molds of common gray iron, and have worked out a method of impregnating the iron with the zinc.

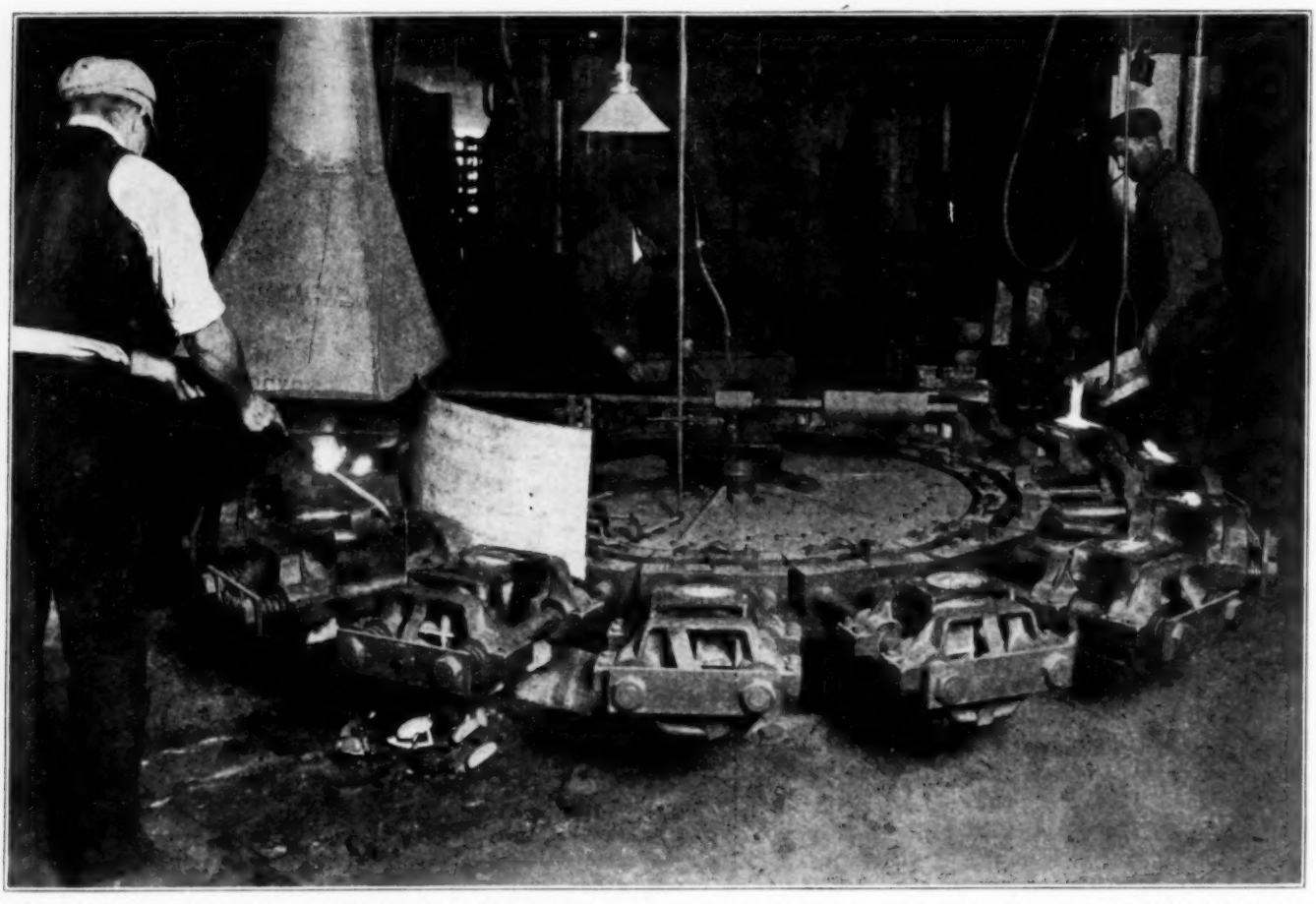


FIG. 3—MACHINE ON WHICH 15 MOLDS ARE MOUNTED FOR CONTINUOUS POURING. CLEANING AND DEPOSITING LAMPBLACK ON THE MOLD AND THE OPENING AND CLOSING ARE ACCOMPLISHED AUTOMATICALLY

Before impregnating, the mold castings are cleaned in an acid bath. They then are placed, together with some powdered zinc, in a container which is practically air-tight. The container, casting and zinc then are heated for about 12 hours at a temperature of approximately 900 degrees. Since cast iron has a great affinity for the zinc, zinc is impregnated to considerable depths. When the mold is in service, the coating of zinc gradually gasifies, and some is lost, as the molten metal strikes the mold, but the cast iron mold surface is not damaged. Through experiments that have been

conducted, it is estimated that the life of the impregnation is at least 10,000 castings, after which it may be necessary again to impregnate the cast iron mold. To prevent undue wastage of the gasifying material and also to lubricate the mold surfaces, the faces are treated with lamp black before the molten metal is poured. Incidentally, this heavy coating of soot serves as an excellent insulator, and further protects the mold from erosion.

The temperature of the molten metal as it strikes the surface of the mold causes an extremely small amount of the zinc to gasify, thus setting a thin film of gas between the metal and the mold. One of the troubles encountered in designing the mold was to overcome the tendency of this gas to be distributed unequally around the surface of the mold. This generally results in bleeding after the casting has been discharged. However, this trouble has been overcome through the design of the mold. The gas in the mold sets up a pressure on the molten metal which is equally distributed. This is shown by the metal in the gate being pushed up to a slight extent instead of being pulled down into the mold as the metal cools.

The castings made by this permanent mold process not only are soft and machineable, but are fine grained and free from flake graphite which would form cleavage planes. The carbon is in the finely divided form, and the castings are tough.

To Produce Chills

Automobile pistons made in molds of this type, have approximately the following chemical analysis: Silicon, 2.25 to 2.30 per cent; sulphur, 0.04 to 0.05 per cent; phosphorus, 1.18 per cent; manganese, 0.50 to 0.60 per cent, with a trace of chromium and nickel. The total carbon runs 3.20 per cent, of which .10 per cent is in the combined form and the remainder in the finely divided form found in castings poured in permanent molds.

By changing the thickness of the mold, chills may be produced where desired. This feature is best illustrated in plow points, which now are being made successfully by this process. These have three chilled cutting edges produced by decreasing the thickness of the mold to such an extent that the heat is taken from the metal quickly and dissipated, thus causing a chill. The molds for making plow points are shown in Fig. 1.

After it was shown through many experiments that cast-iron molds, impregnated with zinc would be satisfactory, other problems of practical foundry importance arose. The proper design of the mold to maintain a uniform film of gas and to prevent or regulate chills already has been mentioned. Another problem developed in designing a mold is to make long castings of relatively thin section. These, due to their shape, warp and twist after absorbing heat from the molten metal. In making sashweight castings, it was found that the skin of the mold became sufficiently heated to give it a convex curve. The two halves of the mold would not fit perfectly and the molten iron when poured into the mold ran out through the cracks, thus forming a bad flash on the casting.

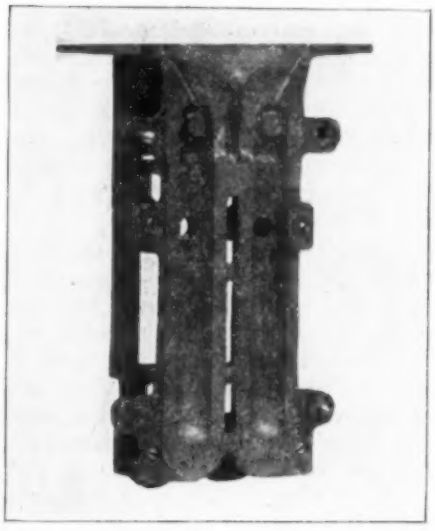


FIG. 4—ONE-HALF OF THE RIG FOR MAKING SASHWEIGHT CASTINGS

Mr. Lee has developed a remedy for this condition which has worked satisfactorily. Each half of the mold is made up of two parts, namely the mold and the sub-head or floating head. One half of the mold for making sashweights is shown in Fig. 4. The mold proper has a sloping surface at both top and bottom on the back, the bevel being toward the top and bottom respectively. The mold is mounted on the subhead, there being three points of contact. The two parts are attached with bolts at a point near the center of the mold which through a series of experiments has been found to give the best results. The ends of the subhead are beveled, but in the opposite direction to the mold proper so that the two surfaces fit tightly when the mold is bolted to its backing subhead.

As the temperature of the molten metal causes the cast iron mold to heat, there is a tendency for the mold to elongate and the ends to twist or warp away from the other half of the mold. As the mold elongates, the inclined surface of the subhead pushing against the inclined surface of the mold forces the two ends of the mold face inward, thus keeping the two halves of the mold in perfect alignment.

A device also has been developed to compensate for any warping of the subhead due to heat that may be absorbed when the molds are in continuous use for long periods of time. Four holes are bored through the subhead, two about 1-inch from each end. The holes are threaded and a screw plug provided. A round plug then is inserted in the hole and pressure applied by the screw plug. The round plug is made from a metal having approximately two times the thermal expansion of the cast iron, so that as the ends of the subhead tend to bend outward, the expansion of the plugs continues to hold the mold face in the proper alignment. The company has tested this device for keeping the face of the mold true by operating for a long period, a mold making two sashweights together. A sashweight 22 inches long was formed on one side and one 7 inches long on the other, thus producing an unequal distribution of heat in the iron mold. The test showed that the design of the mold was such that no warping was experienced.

Gating the Molds

A feature that has been given considerable study relates to gating the molds. It is necessary to deliver the iron to the mold at the proper points and at the correct speed. In case of the pistons, the molds are gated through sand cores, although a gate in the mold proper would work equally well. The cores are prepared in the same manner as for sand molds and a facing is applied to produce a smooth finish on the casting.

Some time was spent in developing a method for holding the cores concentrically, in spite of the mold expansion. In making castings with thin walls, such as pistons, it is important that the core be held exactly in place, for if the core shifts 1/32 or 1/16-inch, the thickness of the wall will be changed a like amount and the casting will be spoiled. The principle that various metals expand differently when heated again was used in this connection. When the core is in place and the mold closed, metal plugs hold the core firmly in place. These plugs have approximately twice the coefficient of expansion of cast iron, so that as the mold expands outward the plugs push inward and continue to hold the core. This also is accomplished by a plug regulated by

a spring made of two different metals.

The H. S. Lee Foundry & Machine Co., also has designed a machine for the continuous operation of the permanent molds. This machine, which is shown in Fig. 3, is 12 feet in diameter and about 2 feet high, and has heads for 15 molds. The speed of operation depends on the type of casting made, for the various heads are mounted on the machine as occasion demands. The illustration shows the equipment for making pistons, 15 castings being made in two minutes or 440 an hour. Approximately 660 plow points may be made per hour on the machine.

The machine is driven by a 3-horsepower motor through gears which may be changed to regulate the speed. A special clutch also is installed which automatically throws the machine out of gear if a mold sticks or trouble develops in the line. Three men are required in operation; one to set the cores, one to pour and the third to carry away the castings as they are dropped from the molds.

All parts are protected from dust and dirt and from metal which is spilled, thus preventing serious delay from shut downs.

A saving in the melting cost results from using the permanent mold process, since it is possible to pour the metal at lower temperatures than is the case when making the castings in sand molds. Castings, which are being made on a production basis at the Lee foundry, are being poured at a temperature of 2100 to 2200 degrees Fahr.

As shown in Fig. 3, the mold opens at the extreme left. As it moves along a jet of air cleans any loose particles from the face. The lamp black is applied by two flames playing on the surface of the mold. The jet for the gas flame is suspended on a rod which is attached at the center of the machine and balanced by a weight as shown. Lugs on the frame of the machine catch a rod attached to the carbon depositng device and move it along with the mold. A cam attached to the main rod operates on an inclined plane raising the flame from the bottom to the top of the mold, and thus depositng an even film of carbon. As the flame reaches the top of the mold face, the device trips and drops back, the operation being repeated on the next mold.

As the mold is carried around to a point shown in the rear the cores are set in place. The mold then closes and is poured at the right. The time between the pouring and the kick-out is important, for if left in too long the casting surface will be chilled and if kicked-out too soon the shell will be thin, allowing the molten metal at the center to push out or bleed, thus spoiling the casting. Pistons are allowed to cool 25 seconds. The castings are discharged into the pan at the left.

Another important step in the process is the self-annealing of the castings after they are removed from the mold. Each casting is plunged into a powdered mass of special composition, the insulation value of this material being so great that the castings remain hot for many hours, cooling gradually. This feature not only prevents any surface chill, but even more important, it eliminates the formation of iron oxide, making the castings soft and machinable. The time the castings are allowed to cool in this packing depends on the size and thickness of the metal. The pistons are allowed to remain 4 hours.

PurchaseMuskegonPlant

F. T. Kennedy, formerly connected with the Saginaw Malleable Iron Co., Saginaw, Mich., and the Central Malleable Castings Co., Franklin Park, Ill., and W. P. Stout, formerly connected with the Terre Haute Malleable and Mfg. Co., Terre Haute, Ind., have purchased the plant in Muskegon, Mich., formerly occupied by the Muskegon Castings Co. This property consists of about eight acres, the main building containing about 50,000 square feet of floor space in addition to other buildings such as the compressor house, storeroom, pattern vault and the concrete sand bins. The plant will be known as the Muskegon Malleable Castings Co. Construction of the furnace and annealing ovens now is well under way and it is expected operations will begin about May 15.

Tells Company History

"Forty Years of Progress" is the title of a catalog which has been published by the H. Harnischfeger Corp., Milwaukee, describing the history of the company since its establishment in 1884. The first portion of the publication is devoted to the history of the company, pictures and sketches of the officers and sales force. The second portion describes a trip through the plant with pictures of various departments including the gray iron foundry, the pattern shop and the steel foundry. The last part is a description of the products made by this company.

Standardization Proposed By Welding Society

Enormous growth in the application of welding to many different kinds of industrial uses has occurred during the past year, according to expressions at the meeting of the American Welding society in New York, April 23-24.

Members of the gas welding committee decided that the present organization is too unwieldy. They decided to appoint an executive committee to meet monthly in New York to direct the work of the gas welding committee. This committee will conceive and assign work to the various members of the gas welding committee, and will receive and correlate resulting reports from the various individuals. Among the subjects to be considered are welding manganese steel, fatigue tests of gas welds, and the standardization, wherever possible, of gas welding practice.

Feasibility of formulating a standard practice of pressures and currents was the subject of a lengthy discussion in the session of the committee on resistance welding. The discussion concluded with an agreement on the part of various experts present to compile data on welding operations during the next year. This material will be used in establishing a formula.

The selection of Boston as the place for the next fall meeting was advocated. It also was proposed that an exhibition, to be open to welding apparatus and to welded products, be held in connection with the fall meeting. These points will be decided later by the directors.

Interest increasingly prevalent in the subject of welding was shown by the growth in membership of the association, whose roll now includes 805 names.

A. G. Oehlers, associate editor, *Railway Age* was elected president. He succeeds E. H. Ewertz in this office. The new vice presidents are George Bird, Bird-Potts Co., Atlanta, and Charles S. Smith, Linde Air Products Co., San Francisco. New directors are James Burke, Burke Electric Co., Erie, Pa., J. W. Meadowcroft, Edw. G. Budd Mfg. Co., Philadelphia, S. W. Miller, Union Carbide & Carbon Research Laboratories, Long Island City, and H. A. Woofter, Thomson Electric Welding Co., Lynn, Mass.

The Hill Clutch Machine & Foundry Co., Cleveland, has appointed T. D. Rose & Son as its representative in Pittsburgh and adjacent territory. Mr. Rose has been prominently identified in the power transmission field for 25 years.

Calculating Ferroalloy Additions

By H. L. Campbell

Assistant Professor, University of Michigan

ONE of the important factors contributing to the economical production of castings is the proper proportioning of the metal mixtures used. All raw metals are purchased directly or indirectly on the basis of their chemical compositions. Therefore, the aim should be to combine the chemical elements to produce the desired composition in the castings. The prices of ferroalloys are relatively high and care should be taken in the use of these materials.

It generally is recognized that the physical properties of the cast metals are dependent to a great extent upon chemical composition. The desired strength and hardness may be attained by regulating the composition of the metal which is poured into castings. The importance of uniformity in quality can not be overestimated in these days of rapid production in the machine shop.

The ferroalloys contain such elements as silicon, manganese, etc., in concentrated form, in combination with iron. They are used to introduce specific elements into the metal to produce a beneficial effect on the qualities of the resulting castings. Usually, it is necessary to use larger amounts of the ferroalloys than is theoretically required to increase the proportion of the special element in the metal mixture. This is to provide for losses due to oxidation or other causes. The losses can be determined experimentally for any given practice.

Attention is called to the fact that the ferroalloys have relatively high melting points. Ferrosilicon containing 50 per cent silicon melts above 2500 degrees Fahr. and ferromanganese with 80 per cent manganese melts about 2300 degrees Fahr. Therefore, the economic use of these alloys, as ladle additions, requires that the metal bath be superheated highly or that the ferroalloys be preheated before adding to the metal in the ladle.

The accompanying chart has been prepared to aid in the rapid determination of the additions of ferroalloys required to raise the percentage of any element to the desired amount. Scale *A* on the chart gives values for the desired increase of the special element. For example, it may be

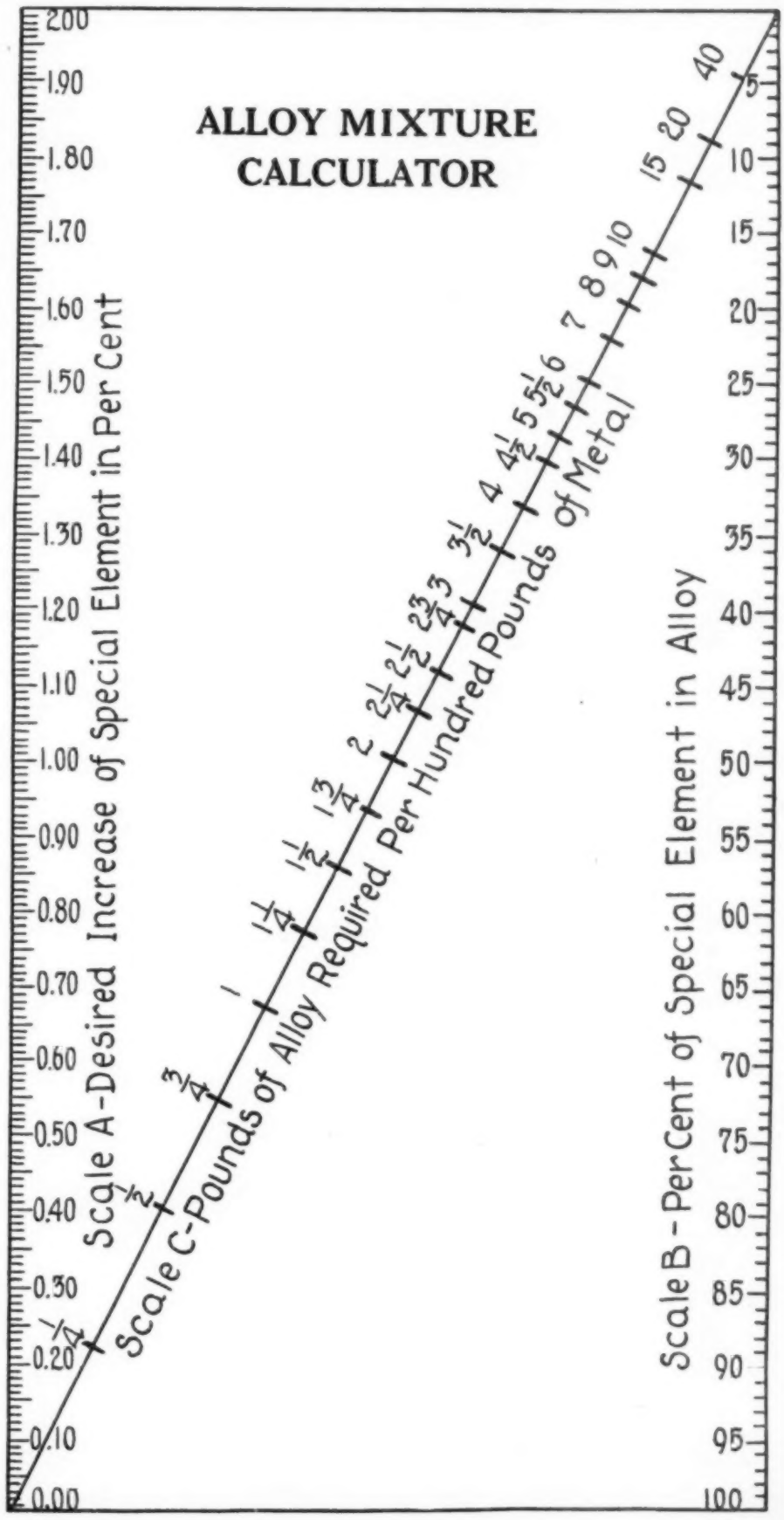


CHART FOR COMPUTING ADDITIONS OF FERROALLOYS OF KNOWN CHEMICAL CONTENT

desired to raise the manganese content of a metal mixture from 0.47 per cent to 1.00 per cent. This would require an increase of 0.53 per cent which may be located on scale *A*. The percentage of the special element in the ferroalloy is given on scale *B*. The weight in pounds of the ferroalloy required for each 100 pounds of metal is indicated on scale *C*. If the metal mixture to which the ferroalloy is added weighs 1200 pounds, it will be necessary to multiply the values given on scale *C* by 12. The following examples will serve to illustrate the use of the chart.

Example 1: How much ferromanganese containing 80 per cent manganese must be added to a ladle holding 1000 pounds of metal, to raise the manganese content of the metal from 0.30 to 0.90 per cent?

The desired increase of manganese is 0.90 minus 0.30 or 0.60 per cent. Connect 0.60 on scale *A* with 80 on scale *B*, and the intersection with scale *C* is at ¾ pound which is the amount of ferromanganese to be added to 100 pounds of metal. As the ladle holds 1000 pounds, it will be necessary to add 10 times ¾ pound or 7½ pounds of ferromanganese to the metal in the ladle.

Example 2: How much ferrosilicon containing 50 per cent silicon must be added to a ladle holding 800 pounds of metal, to raise the silicon content from 1.40 per cent to 2.90 per cent?

The desired increase of silicon is 2.90 minus 1.40 or 1.50 per cent. Connect 1.50 on scale *A* with 50 on scale *B* and the intersection with scale *C* is at 3 pounds which is the amount of ferrosilicon to be added to 100 pounds of metal. As the ladle holds 800 pounds, it will be necessary to add 8 times 3 pounds or 24 pounds of ferrosilicon to the metal in the ladle.

Example 3: How much bessemer ferrosilicon containing 18 per cent silicon must be added to a metal mixture of 1000 pounds, to increase the silicon content of the mixture from 1.83 to 2.25 per cent?

The desired increase of silicon is 2.25 minus 1.83 or 0.42 per cent. Connect 0.42 on scale *A* with 18 on scale *B* and the intersection with scale *C* is at 2¼ pounds, as the metal mixture weighs 1000 pounds, 22½ pounds of the bessemer ferrosilicon will be required.

General Piston Ring Co. has removed its plant and offices from Indianapolis to Tipton, Ind., where an increase of 100 per cent in operating space is provided. A. L. Teetor is president; D. C. Leetor vice president and H. Troutwine, sales manager.

Book Review

Pattern Making, by Joseph G. Horner, fifth edition; 437 pages, cloth, 5½ x 8¼ inches, published by Crosby, Lockwood & Son, Stationers' Hall Court, London, England, price 18 shillings and supplied by THE FOUNDRY, Cleveland, price $5.00.

The fifth edition of this work has made an opportunity for the author to effect a thorough revision and rearrangement of the original text. The sequence of the chapters has been changed and numerous additions have been made.

The work now covers an extensive field ranging from elementary construction to the pattern work required for gear wheels, and machine molding. It includes valuable information on foundry requisites, engine beds, base plates and cylinders, boiler fittings and mountings, pumps, cocks, and valves fluted and ornamental columns, strip pulleys, sheave wheels, chain barrels, water wheels and turbines, and machine molded wheels.

The appendix gives tables of diameters, circumferences, and area of circles, tables of squares, cubes, square root, and cube root, and of decimal equivalents, tables of pitches, pitch diameters, and number of teeth of wheels. This latest edition contains over 600 illustrations and is fully indexed.

Quad City Meeting Hears Piece Work Figures

The regular monthly meeting of the Quad City Foundrymen's association was held April 20 at the Rock Island club, Davenport, Iowa, with an attendance of about 100 members.

The papers discussed at this meeting were the two methods of determining piece work molding prices. The first method was the cubic inch or volume method which was discussed in detail and examples shown by W. M. Thomas, Union Malleable Iron Works, East Moline, Ill. He explained the volume method, the base on which the price for each size flask was figured and to which was added such extras as setting cores, chills, number of patterns on the gate, etc.

The second method, the weight method, was discussed by John H. Ploehn, French & Hecht, Davenport, Iowa. In this latter method the complete weight of the mold is used. He explained the base, to which was added extras for setting cores of various sizes, chills, loose pieces and such other additional operations as will be found necessary.

A system for figuring the pouring prices to be used with various size castings was also explained by Mr. Ploehn, as well as a bonus which is paid the molder who keeps his loss to the lowest percentage.

Encounters Gas Pockets in Gear Wheels

By George A. Drysdale

Question: We are sending you a section of gear wheel casting showing a defect which we believe is caused by gas. This defect has caused considerable argument and we would be pleased to have you comment on the cause. You will note that the gas appears to start in on the drag side of the casting.

The analysis of this casting follows: Silicon 2.35 per cent, phosphorus 0.18 per cent, manangese 0.63 per cent and sulphur 0.084 per cent. The silicon we believe is higher than it should be due to other work in the shop requiring soft iron.

Answer: After carefully examining the casting which you forwarded for examination, we agree with you the faults are gas pockets caused by pouring the metal into extra damp green sand molds or a cold cast iron mold. Your object evidently being to close the grain of the metal as much as possible on the exterior to produce stronger teeth in the gear. The chemical analysis shows a soft gray iron which is apparent on examining the fracture of the casting, especially at the center.

The trouble evidently is due to gas trapped by the rapid solidification of the metal. The trouble may be overcome by venting the molds, drying the green sand mold or heating the iron mold before pouring. Instead of trying to close the surface grain of the metal by such methods, close the grain of the metal by lowering the silicon in the mixture which we believe will eliminate your present trouble.

Will Market Metal

The Du Pont Everdur Co., Wilmington, Del., has been incorporated to produce a corrosion resistant alloy. The officers of the company are: President, H. Grubb; vice president, H. M. Pierce; treasurer, J. B. Eliason; secretary, Charles Copeland; assistant secretary, M. D. Fisher.

C. W. Ross, formerly with the Beaumont Co. has been appointed manager of the Philadelphia office of the C. O. Bartlett & Snow Co., designer and builder of materials handling and processing equipment, Cleveland. The Philadelphia office is located at 807 Schaff Building.

Making Die Castings of Nonferrous Metals

By Marc Stern

MR. STERN received his first mechanical experience in the shops of the Erie railroad and the S. S. White Dental Mfg. Co.

HE WAS graduated from Stevens Institute of Technology, Hoboken, N. J. in 1912, *receiving the degree of mechanical engineer.*

SHORTLY thereafter he became identified with the die casting industry in charge of engineering and research work.

HOLDS membership in numerous engineering societies, this paper having been presented at the March meeting of the Detroit branch of the Society of Automotive Engineers.

THE art of casting metals into previously prepared molds has been known and practiced since prehistoric times. The casting of metals is referred to in many passages of the Bible, the most prominent being that of the casting of the golden calf. A whole series of molds belonging to the first dynasty of Egypt (about 2400 B. C.) has been unearthed. They show that the molds were carved in thick pieces of clay, baked into pottery, and lined with a fine ashy clay. In the lake dwellings of Switzerland, various molds have been found dating from 1000 to 2000 B. C., made either of rock or clay. Rock seems to have been preferred for the flatter objects, and clay for the more complicated castings. These molds were made of two or more parts, suitably dowelled, so that they could be joined.

Casting in sand molds on a commercial scale started in England at the beginning of the eighteenth century. The first appearance of the metal molds seemed to have come with the advent of printing during the middle part of the fifteenth century, which reached its highest state of development in the modern monotype and linotype machines.

This brief historical review is made to show that the casting of metal in molds which may be used over again, and which is the basis of the art of die castings, is really the forerunner of the process for casting in sand.

Die casting, as it is known today, is a comparatively recent art in its commercial applications. It developed with the growth of large production methods in the manufacture of interchangeable parts. Die castings were first applied to such devices as cash registers and phonographs, and it was not until 1904 that they were applied in the form of bearings for automobiles.

Rapid growth of the automobile industry served as a stimulus for the study and developments of aluminum die castings, which made their first appearances in 1914. Today, about 75 per cent of the productive capacity of the die casting industry is devoted to the manufacture of parts for automobiles and their accessories, in such forms as speedometers, magnetos, oil pumps, lighting systems, spark and throttle levers, body hardware, etc.

Some confusion still exists as to the exact definition of the term *die casting* since there are many different

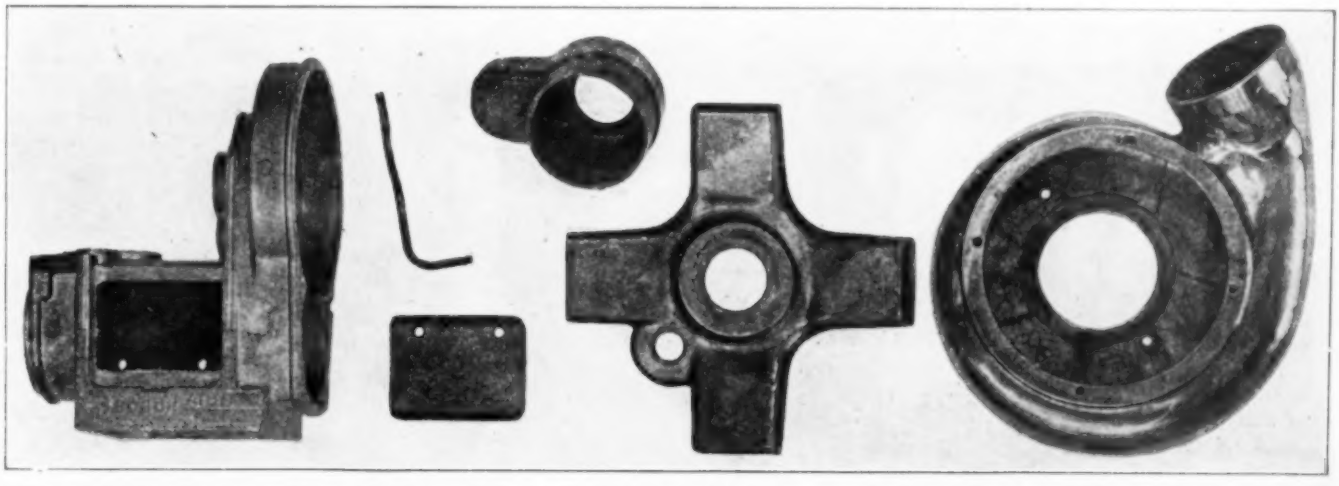


FIG. 1—INSERTS USED IN THE MAGNETO HOUSING ARE SHOWN SEPARATELY. THE ALUMINUM STEERING WHEEL HUB IS CAST OVER THE INSERT. THE FAN HOUSING SHOWS THE FINS LEFT BY THE SECTIONS OF THE CORE

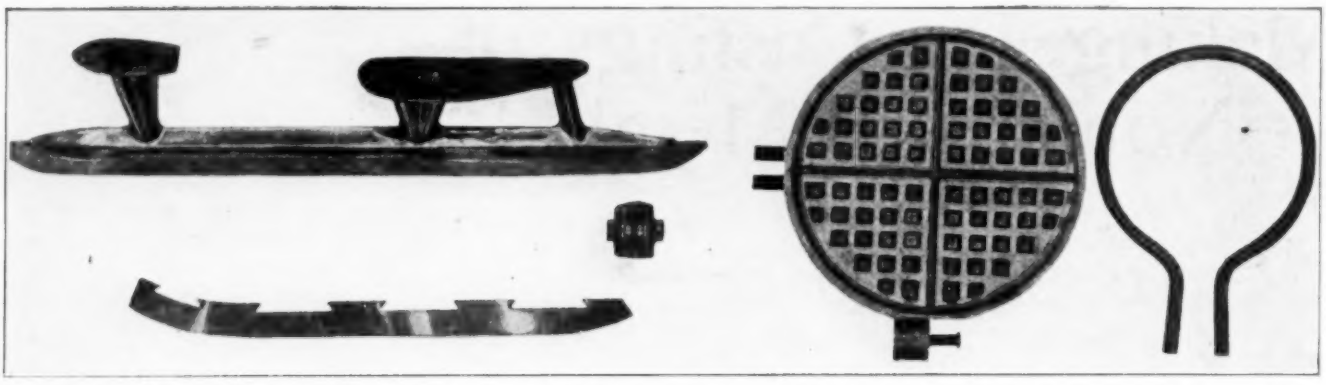


FIG. 2—ALUMINUM SKATE WITH HARDENED STEEL RUNNER AND METHOD OF ANCHORING. WAFFLE MOLD AND ELECTRICAL HEATING ELEMENT ARE SHOWN

methods of producing castings outside of the sand cast field. Such castings may be produced either in metallic or nonmetallic long life molds, or in combination with destructible cores. They may be filled by gravity, known as *permanent-mold castings*, by centrifugal force, known as *centrifugal castings*, or filling the mold by gravity and after the outer skin is chilled, pouring out the excess liquid metal, known as *slush castings*. A *die casting* may be defined as one formed in a metallic mold or die, from metal subjected to mechanical or gaseous pressure while in the molten state.

It is important to contrast this definition with so called *pressed castings* or drop forgings where the pressure is applied while the metal is in a plastic or semiplastic condition, making impractical the coring of side holes. In die castings, the metal being liquid, the pressure is practically uniform in all directions, and complicated coring of holes and side cavities therefore is accomplished easily. The molten metal coming in contact with the comparatively cold surfaces of the mold, chills immediately and the feed of the metal is maintained under full pressure until the die casting has solidified completely. The sudden cooling forms a smooth hard skin on the surface with a comparatively coarser structure at the center of the walls.

Die castings may be subdivided into low pressure castings, in which the molten metal is subjected to pressures of several ounces up to 25 pounds per square inch; and high pressure castings varying from 50 to 1000 pounds per square inch. The former produces a dense internal structure with the tendency for imperfections on the surface, due to uneven shrinkage. This process is limited to designs of a comparatively simple nature. High pressure die castings have a broader field of application, this paper being confined in its treatment to this type of die castings.

Porosity is an inherent feature of commercial high pressure die castings. At first it was believed that this was due to the presence of air. The vacuum process was introduced so that the air was drawn out of the die cavity before the metal entered. Even if it were possible to maintain a vacuum under practical working conditions, this method does not offer the complete remedy. Practically the same results may be obtained without a vacuum, if the proper size and location of the gate and vent grooves are carefully considered.

There are two other causes for porosity, namely uneven chilling of the metal and drossy or sluggish metal. To illustrate the first cause, consider a die casting gated so that the metal must travel through a thin section to reach a heavy boss. Normally the boss will solidify last, but since the thin section between it and the gate is already frozen, it has nothing to draw from to satisfy its natural shrinkage, and the difference is made up by a void or hole in the center. This emphasizes the importance of proper distribution of water channels in the die.

The second cause is self evident, for a die casting cannot have a cleaner structure than the original alloy. If the alloy becomes contaminated with too many impurities, its flow becomes sluggish and it chills before the shrinkage is satisfied even in uniform walls. However, the outer crust is so much greater in density and strength that it more than compensates for the porous structure in the center of the wall.

An interesting illustration of how air becomes trapped in the die casting is shown in Fig. 6. It represents

FIG. 3—CHECK PROTECTOR HOUSING AND MOTOR HOUSING FOR VACUUM CLEANER. ELBOW SHOWS USE OF LOOSE CORE

a solid cylinder 2-inch outer diameter, ½-inch inner diameter and 1½ inches high with the gate at the bottom. The metal was forced under comparatively low pressure into a cold die so that the metal chilled before the impression filled completely. It clearly shows the flow lines and the tendency to cling to the surface of the die. The way is shown in which the castings solidified at the top, preventing the escape of air. This is an exaggerated condition, because die castings usually do not have such heavy walls, and the running condition of the die was abnormal. However, it indicates the tendency for porosity.

The die casting process is adapted best to alloys of comparatively low fusing points and may be subdivided into the following four groups:

Group *A*, tin-base alloys: The main ingredient is tin, 60 to 90 per cent, alloyed with 3 to 7 per cent copper, and a similar amount of antimony. The alloys with the lower tin content contain 10 to 25 per cent lead. The maximum fusing point is 450 degrees Fahr. and the tensile strength around 8000 pounds per square inch. These alloys produce castings of fine sharpness and finish. The high cost of tin largely limits its use.

Group *B*, lead-base alloys: The main ingredient is lead, 80 to 95 per cent, alloyed with antimony alone or in combination with tin up to about 10 per cent. The maximum fusing point is 600 degrees Fahr. and the tensile strength is about the same as that of the tin base alloys.

Zinc-Base Alloys

Group *C*, zinc-base alloys: The main ingredient is zinc, 88 to 95 per cent, alloyed with tin and copper or aluminum and copper. The melting point is around 780 degrees Fahr. and tensile strength varies from 16,000 to 35,000 pounds per square inch, depending upon the grade and proportion of the elements. These alloys resemble cast iron, being hard and somewhat brittle against blows.

Group *D*, aluminum-base alloys: The main ingredient is aluminum, about 90 per cent, alloyed with copper, nickel and silicon. The melting point is 1150 degrees Fahr. and the tensile strength is 18,000 to 21,000 pounds per square inch.

In spite of the fact that the aluminum alloys present difficulties in handling, such as shrinkage, great affinity for ferrous metals of which dies are made, castings are being made successfully on a commercial basis of these alloys. Brass castings are being produced commercially in metallic and also in plastic nonmetallic molds,

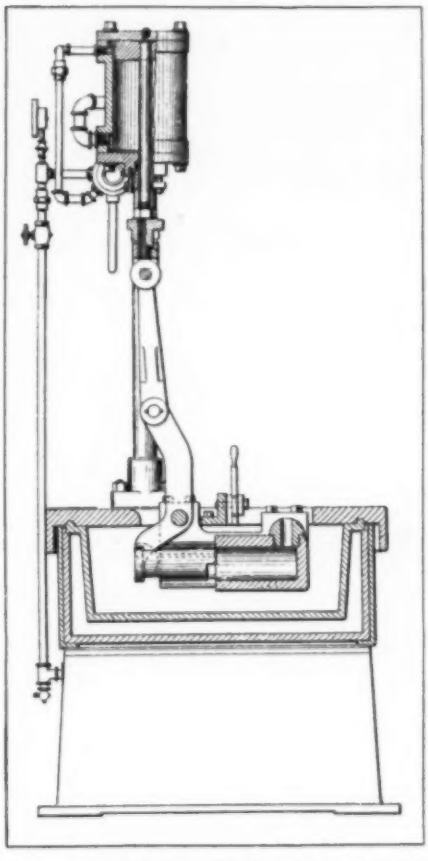


FIG. 4—PLUNGER TYPE OF CASTING MACHINE

and closely resemble die castings in appearances, surface finish and accuracy.

No specific rules may be laid down governing the design of die castings, since frequently a design, which ordinarily might be considered impractical, may be produced by special methods as illustrated by the castings shown in Figs. 1, 2 and 3. It also is possible, by slight modifications in design, to apply standard casting methods without impairing the function of the part. Best results are obtained when the designer of a new device requiring die castings consults specialists in this line, when the entire design is still on paper. The functional as well as the casting production features then may be properly co-ordinated.

The observance of the following general rules, should produce durable and economical designs: Avoid undercuts which makes a core impossible to withdraw unless it is made up in sections. This is of no consequence in sand foundry practice because the core is destroyed with each casting.

Avoid sharp corners. It is more important than in sand castings, because the rapid chilling of the metal, and the unyielding consistency of the mold, is likely to set up a strained section. Therefore fillets should be used freely.

Ribs Are Desirable

Ribs or webs are desirable, especially on thin flat surfaces. They not only help to fill the casting to better advantage, but they add strength. A thin wall properly ribbed is far stronger than a plain thick wall, because the former has a larger area of chilled outer skin.

Raised engraving should be specified on the die casting whenever possible because it is the most economical to produce. It may be placed on a depressed panel if the engraving must not project above the rest of the surface.

External or internal threads may be die cast, but an extremely fine pitch should be avoided. Internal threads as a rule are not practical for aluminum because of its dragging tendency and high shrinkage. Internal threads under about ¾-inch in diameter usually are not cast since they may be produced more economically by tapping.

Spur gears or bevel gears with

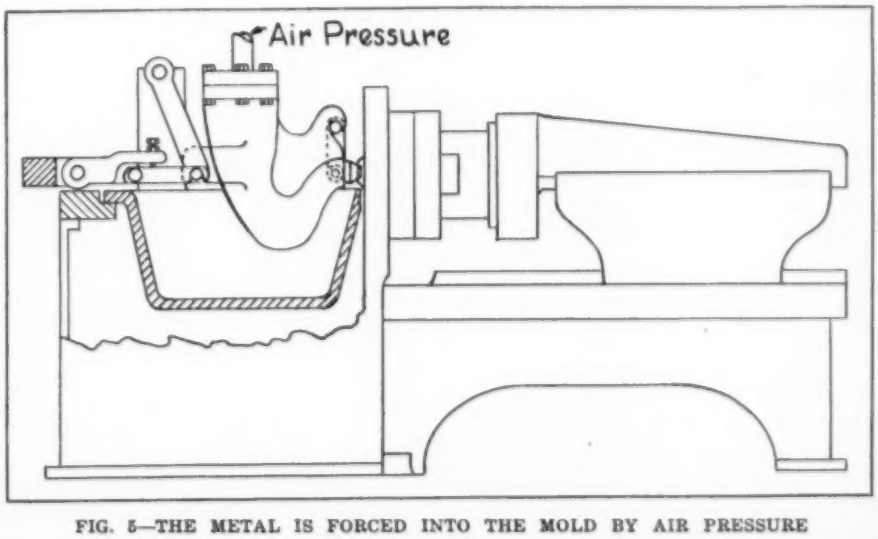


FIG. 5—THE METAL IS FORCED INTO THE MOLD BY AIR PRESSURE

straight or spiral teeth are die cast for light service. Whenever possible a shroud should be added on one side.

Bushings may be die cast with straight or spiral oil grooves, but they should preferably be made to run out at one end.

Inserts should be used when greater strength, hardness, or bearing qualities are needed at localized points of a die casting. They also are used to reduce cost of assembly, to provide lubricating channels to inaccessible points, or provide magnetic qualities, such as pole pieces in magneto housings.

Wall thickness may be reduced as low as 1/32-inch for tin and lead alloys, 3/64-inch for zinc alloys and 1/16-inch for aluminum over small areas. For large surfaces the wall thickness should be at least 1/32-inch greater.

Minimum diameters for shallow holes may be cast as small as 1/64-inch for lead and tin alloys, 1/32-inch for zinc alloys, and 3/64-inch for aluminum alloys.

Accuracy of a die casting depends upon the wear of the die and the shrinkage of the alloy. The latter varies with temperature of the molten metal, temperature of the die, and the time element required in ejecting the casting. Dimensions formed by slides or the parting line of the die, will vary more than those formed in a solid block. A sizing operation should be allowed for where extreme accuracy is needed in a die casting.

Tin and lead base die castings may be held to a total variation of 0.001-inch per lineal inch or fraction thereof. In the case of zinc and aluminum alloys this total variation would be 0.002 and 0.004-inch respectively. These figures represent average conditions, and are not always in direct proportion to the total length of the die casting.

Machining Die Castings

Die castings, as they leave the die, have flashes of metal attached which are known as *fins*. They are more pronounced along the parting surface of the die due to the spring when the metal is forced in, and to the intentional vent grooves ground on the die surfaces. Fins also will form around cores, slides, ejector pins, and other movable parts. Even around stationery blocks, fins eventually will form, due to the constant expansion and contraction and the stretching of the holding screws. However, these difficulties are at a minimum when the dies are constructed securely, lubricated properly, and the surfaces kept clean during the casting operation.

Tools for die castings should be made of high speed steel and ground with acute cutting angles. The clearance and rake for zinc may be about the same as that for steel, and practically twice as much for aluminum. It may be greater for the tin and lead alloys. Taps, reamers and milling cutters should be provided with large flutes for chip clearance. The cutting speeds for zinc die castings are 15 to 25 per cent faster, and for aluminum 30 to 50 per cent faster than the speeds for cast iron. The

FIG. 6—AIR OFTEN BECOMES TRAPPED IN THE CASTING

feed however, should be about 20 per cent slower.

The cutting edges must be kept sharp because of the tendency to tear, particularly in the aluminum alloys, of low copper content. In the case of zinc die castings with thin walls, cracks may develop due to the wedging action of a dull tool. Holes for tapping should be about 0.003-inch larger in diameter than standard practice to prevent crowding of the tap.

The main precaution in soldering zinc die castings is to maintain a temperature below 250 regrees Fahr. to prevent sweating out of the tin constituent. The castings also must be handled carefully since zinc alloys are weak when hot. A suitable flux is a solution of zinc chloride. Powdered rosin also may be used, but it is more difficult to handle. A low fusing point solder should be used which must be thoroughly rubbed into the surface with a soldering iron, so that it may alloy with the zinc. When possible, the casting should be warmed all over before applying the iron, so that excessive heating at the soldering point will not be needed to compensate for conduction of heat to the cold sections.

Soft canvas wheels, or wheels consisting of sections of stitched buffs glued together may be used to polish white alloy die casting. The emery is applied in the usual manner by first coating the wheels with a good grade of glue. The grade of emery depends upon the quality of finish desired, and composition of the alloy. It is essential that the wheels be kept wet or greasy with fat or tallow. Care must be taken not to grind too much below the natural dense surface of the die casting, thereby reaching the porous structure usually present toward the center of the wall. Zinc die castings should not be permitted to become so hot in polishing that they cannot be touched with the hand. Otherwise, cracked castings will result, and if tin is present it will sweat out leaving minute holes on the surface which frequently is the cause of blistered plating. Aluminum die castings may be given a satin finish either by dipping in suitable chemicals or by the use of a special wire brush wheel after the grease or oil is removed from the surface.

Enameling Die Castings

All die castings may be enameled readily providing the thin film of oil or grease due to handling or machining is removed by dipping in a suitable wash. Sand blasting causes the enamel to stick much better to the smooth surface. Enamels requiring a baking temperature of no higher than 250 degrees Fahr. should be used for the low melting point alloys, otherwise tin, which is present in many zinc die castings, will sweat out and cause trouble. Zinc die castings free from tin may be baked at a somewhat higher heat, but care must be taken not to reach the critical temperature, or the castings will become brittle. The most satisfactory results may be obtained with an air dryed enamel which eliminates the necessity of a final baking.

Zinc die castings may be plated readily. This gives the castings an improved appearance, and the necessary protection against oxidation and deterioration, which is an important factor in zinc alloys subjected to the action of the elements.

Certain simple precautions should be exercised to obtain the most satisfactory results. Grinding too far below the surface should be avoided. Zinc die castings may be given a direct plating of nickel, but for fine work a copper or brass strike before final plating is desirable. Since zinc

(*Concluded on Page* 408)

FACTOR CHART FOR TENSILE STRENGTH

The following factor chart will be found to be of advantage in figuring the tensile strength of test pieces in pounds per square inch. The chart covers rounds, squares, and flats.

Formula: Actual pounds on test machine × Factor = Lbs. per square inch (tensile strength).

Size Round Inches	Factor	Size Round Inches	Factor	Size Square Inches	Factor	Size Square Inches	Factor
3/16	81.499	1 1/16	1.128	3/16	64.000	1	1.000
1/8	52.165	1 3/16	1.006	1/8	40.960	1 1/16	.886
5/32	36.219	1 1/8	.903	5/32	28.444	1 3/16	.790
3/16	26.610	1 1/4	.815	3/16	20.898	1 1/8	.709
1/4	20.371	1 5/16	.739	1/4	16.000	1 1/4	.640
5/16	16.095	1 3/8	.673	5/16	12.642	1 5/16	.580
11/64	13.038	1 7/16	.616	11/64	10.240	1 3/8	.529
3/8	9.054	1 1/2	.566	3/8	8.463	1 7/16	.484
13/64	8.344	1 9/16	.522	13/64	7.111	1 1/2	.444
7/16	6.652	1 5/8	.482	7/16	5.224	1 9/16	.410
15/64	5.093	1 11/16	.447	15/64	4.000	1 5/8	.375
1/4	4.024	1 3/4	.416	1/4	3.160	1 11/16	.351
9/32	3.259	1 13/16	.387	9/32	2.560	1 3/4	.326
17/64	2.694	1 7/8	.362	17/64	2.116	1 13/16	.304
9/32	2.263	1 15/16	.339	9/32	1.778	1 7/8	.284
19/64	1.929	2	.318	19/64	1.515	1 15/16	.266
5/16	1.663			5/16	1.306	2	.250
21/64	1.449			21/64	1.138		
1	1.273						

(Continued on Data Sheet No. 574)

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

FACTOR CHART FOR TENSILE STRENGTH

(Continued from Data Sheet No. 573)

Size Flat Inches	Factor	Size Flat Inches	Factor	Size Flat Inches	Factor
1/8 x 3/16	128.000	1/8 x 6	2.667	3/16 x 6	1.333
1/8 x 1/4	64.000	3/16 x 1/4	32.000	1/8 x 1/16	7.314
1/8 x 3/16	42.667	3/16 x 3/16	21.333	1/8 x 1/4	21.333
1/8 x 1/2	32.000	3/16 x 1/2	16.000	1/8 x 5/16	14.222
1/8 x 5/16	25.600	3/16 x 5/16	12.800	1/8 x 1/2	10.667
1/8 x 3/4	21.333	3/16 x 3/4	10.667	1/8 x 5/16	8.533
1/8 x 7/16	18.286	3/16 x 7/16	9.143	1/8 x 3/4	7.111
1/8 x 1	16.000	3/16 x 1	8.000	1/8 x 7/16	6.095
1/8 x 1 1/16	14.222	3/16 x 1 1/16	7.111	1/8 x 1	5.333
1/8 x 1 1/4	12.800	3/16 x 1 1/4	6.400	1/8 x 1 1/16	4.741
1/8 x 1 3/16	11.636	3/16 x 1 3/16	5.818	1/8 x 1 1/4	4.267
1/8 x 1 1/2	10.667	3/16 x 1 1/2	5.333	1/8 x 1 3/16	3.879
1/8 x 1 5/16	9.846	3/16 x 1 5/16	4.923	1/8 x 1 1/2	3.555
1/8 x 1 3/4	9.143	3/16 x 1 3/4	4.571	1/8 x 1 5/16	3.282
1/8 x 1 7/16	8.533	3/16 x 1 7/16	4.267	1/8 x 1 3/4	3.048
1/8 x 2	8.000	3/16 x 2	4.000	1/8 x 1 7/16	2.844
1/8 x 2 1/16	7.529	3/16 x 2 1/16	3.765	1/8 x 2	2.667
1/8 x 2 1/4	7.111	3/16 x 2 1/4	3.555	1/8 x 2 1/16	2.510
1/8 x 2 3/16	6.737	3/16 x 2 3/16	3.368	1/8 x 2 1/4	2.370
1/8 x 2 1/2	6.400	3/16 x 2 1/2	3.200	1/8 x 2 3/16	2.246
1/8 x 2 5/16	6.095	3/16 x 2 5/16	3.048	1/8 x 2 1/2	2.133
1/8 x 2 3/4	5.818	3/16 x 2 3/4	2.909	1/8 x 2 5/16	2.032
1/8 x 2 7/16	5.565	3/16 x 2 7/16	2.783	1/8 x 2 3/4	1.939
1/8 x 3	5.333	3/16 x 3	2.667	1/8 x 2 7/16	1.855
1/8 x 3 1/16	4.923	3/16 x 3 1/16	2.462	1/8 x 3	1.778
1/8 x 3 1/2	4.571	3/16 x 3 1/2	2.286	1/8 x 3 1/16	1.641
1/8 x 3 3/16	4.267	3/16 x 3 3/16	2.133	1/8 x 3 1/2	1.524
1/8 x 4	4.000	3/16 x 4	2.000	1/8 x 3 3/16	1.422
1/8 x 4 1/16	3.765	3/16 x 4 1/16	1.882	1/8 x 4	1.333
1/8 x 4 1/2	3.555	3/16 x 4 1/2	1.778	1/8 x 4 1/16	1.255
1/8 x 4 3/16	3.368	3/16 x 4 3/16	1.684	1/8 x 4 1/2	1.185
1/8 x 5	3.200	3/16 x 5	1.600	1/8 x 4 3/16	1.123
1/8 x 5 1/16	3.048	3/16 x 5 1/16	1.524	1/8 x 5	1.067
1/8 x 5 1/2	2.909	3/16 x 5 1/2	1.455	1/8 x 5 1/16	1.016
1/8 x 5 3/16	2.783	3/16 x 5 3/16	1.391	1/8 x 5 1/2	.970

(Continued on Data Sheet No. 575)

THE FOUNDRY DATA SHEET, MAY 15, 1925

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Around the World with The Foundry

Little Journeys to the homes of our readers

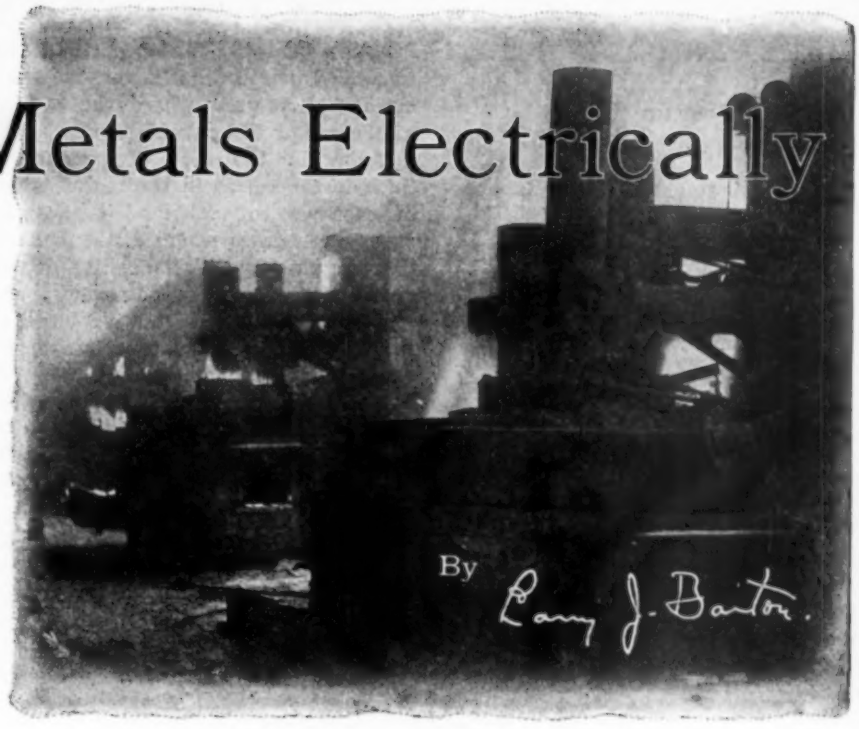
Canal Zone

A BURNING tropical sun, dense and matted vegetation, swamps that reeked with poisonous vapors and swarms of mosquitoes that inoculated men with the deadly yellow fever delayed the building of the Panama Canal for hundreds of years. Hundreds of thousands of lives were lost and millions of treasure were sacrificed in vain between those far off days when Coronado and his conquistadors first saw the waters of the Pacific and the other day when the canal was opened to the ocean borne traffic of the world.

With a minimum depth of 42 feet and a maximum depth of 75 feet the canal stands out as the most colossal engineering feat ever undertaken and carried to a successful conclusion by the hand of man. Not the least important factor in building the canal and now fully as important in keeping it in operation are the exceptionally well equipped iron, steel and brass foundries maintained by the United States government at Balboa. It is not merely a coincidence that four of the executive officers at these shops receive The Foundry in their mail twice a month, it is what one naturally would expect.

"Wherever metals are cast you'll find THE FOUNDRY"

Refining Metals Electrically



Chapter VI

Quality Gray Iron Made in Electric Furnace—Acid Practice

AS THE use of the electric furnace in the manufacture of steel castings became more common, it was natural that its use for melting gray iron should follow. Many electric steel foundries also manufactured iron castings, and when the great refining ability of the electric furnace became known, it was assumed that such a characteristic would materially aid in increasing the quality of the iron itself.

The result of such supposition was a trial of making cast iron by the electric process. It soon was noticed that such a treatment was exceedingly beneficial, and experiments were made to determine exactly the results and direct benefits which would accrue from such a treatment.

The first point of great importance was the ability of the electric furnace to furnish iron at a high temperature. When this is compared with the average cupola practice its manifest advantages can be observed. Cupola operation may be classified by a temperature gradient into three sections:

Those foundries producing iron at 2600 degrees Fahr. or over.
The average foundry with iron at 2500 to 2600 degrees Fahr.
Poor practice with the iron under 2500 degrees Fahr.

As cast iron melts at 2250 degrees Fahr., and freezes at about 2100 degrees Fahr., the practices classified offer molten iron superheated from approximately 200 to 400 degrees Fahr. When it is considered that the average loss in heat of iron from the cupola to the time of actually pouring the mold is about 200 degrees Fahr. it readily is seen that the cupola melting does not heat the iron to high enough temperature. The direct result is to increase the percentage of lost castings, from such items as misruns, cold shuts, shrinks, etc.

With the electric furnace, the direct opposite to this is the rule. The metal may be heated readily to 2750 degrees Fahr., offering sufficient leeway not only to take care of the lost temperature due to handling on the floor, but to provide sufficient temperature at the mouth of the mold to incure a clean run. Hot iron, poured in a mold, has a much greater chance to give a thoroughly solid casting than one poured at a temperature only a few degrees above the point of solidification. Consequently, superheating the metal is the first great advantage of the electric furnace.

This is true not only of the standard irons, containing a high percentage of phosphorus, but is equally true of the so-called high strength irons, which are notably difficult to make in the cupola for small or intricate work. With the electric furnace iron can be poured with ease which would offer great difficulty if made in the cupola.

The second point of advantage is that of being able to reduce the sulphur coincident with superheating, and during the same operation thoroughly to deoxidize the metal. Sulphur is directly accountable for many foundry difficulties, being one of the prime causes of hard spots, dirty inclusions, and weakening of the iron by breaking up the continuity of the structure. It may be one of the causes behind the cracking of certain castings. It is reasonable to believe that a lowering of the sulphur aids the metal by removing some of these causes of trouble. This point has been proved so many times that further comment becomes unnecessary.

The third point observed is the ability to offer metal of uniform grade over any specified period, with absolute regularity. With modern production methods in the machine shops, such an item is of prime importance and is becoming more widely appreciated. This range of metal passes from the softest irons to those of great strength, made by using large percentages of steel in the mixtures, all of which can be made easily and well in the electric furnace.

Therefore, the main results of elec-

Lure of a Name

ELECTRIC furnace gray iron has had an intriguing interest to foundrymen for the past ten years. During the war, a large plant was projected in Canada to use the great quantity of war material scrap in the manufacture of gray iron castings. Along the western coast, where pig iron is costly and fuel is scarce, the availability of cheap electric power has rendered so-called synthetic iron and gray iron electrically melted, particularly attractive. In this article, the first of a chapter on melting iron in the electric furnace, the author outlines the advantages of the method. He gives in detail the practice followed in melting in an acid lined furnace. However, the acid process possesses limitations which are plainly stated. In the forthcoming issues, the basic process, duplexing and the manufacture of synthetic iron will be described.

tric furnace operation may be classed as follows:

SUPERHEATING

Lowers the percentage of lost castings.

Gives castings of better appearance, and greater solidity.

The size of the heads may be lowered due to the greater fluidity of the metal.

A considerable saving of iron and labor is affected due to a lowering of the amount of pig and ladle sculls.

The metal enters the mold in a cleaner state, the impurities rapidly tending to clear themselves from this fluid iron, resulting in lower losses from sand and slag spots.

The iron is naturally of a higher quality and considerably stronger.

REFINING

Electric melting deoxidizes the iron which, constitutes an advantage as great as if steel were being cast.

The sulphur may be lowered to any desired point with many advantages.

Lower sulphurs require lower percentages of manganese constituting an important saving over an extended period of time.

COMPOSITION

Analyses can be made of absolute regularity.

Low phosphorus irons, with their great strength easily and readily can be melted and cast.

Large proportions of steel can be used to give irons of widely varying characteristics.

ECONOMIC

Pig iron can be absolutely eliminated from the charges.

Such a scrap as borings may be readily handled with insignificant losses.

The foundry is independent of the quality of the coke supply.

Large pieces impossible of cupola melting may be used with success.

Even with these advantages, the electric furnace is but slowly gaining a foothold in the iron foundry, due to the high initial cost and expense of operation. The average customer is not interested in the quality of his metal, but desires to receive a nice appearing casting at the lowest possible price. As the cupola can make iron considerably cheaper than the electric furnace, the latter is being more widely used where the quality of the metal far outweighs any slight increase in the cost of production. Such instances, as in the manufacture of castings to withstand high pressures or in cases where metal of absolute regularity of composition is desired, offer the most outstanding examples of the use of the electric furnace. Of course, under certain conditions the electric furnace is cheaper by being able to offer a stronger iron of thinner section such as in pipe work, etc., where this ratio is in favor of electric operation. In parts of the country where power is cheap, and coke and pig iron dear, for instance on the Pacific coast, the electric furnace is coming forward on its cost basis more than on its advantages of producing metal of higher quality.

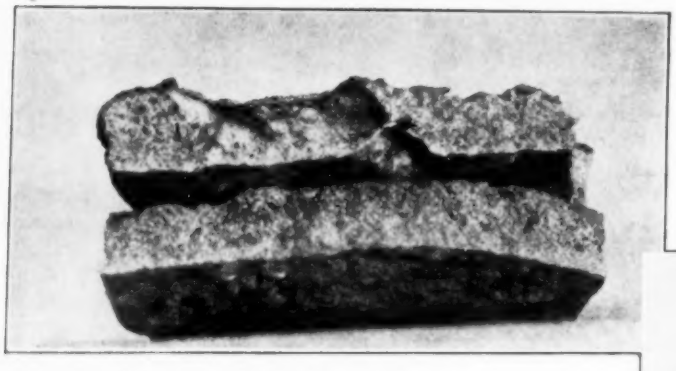


Fig. 46—Note the Numerous Small Shrink Spots Caused by Pouring Iron Too Cold

Fig. 47—Fracture Test of Gray Iron Casting Made From Metal Melted in an Acid Furnace

MELTING GRAY IRON

Acid Operation

THE acid process offers the qualities of superheating only. It has no powers of desulphurizing or deoxidizing by the use of certain slag baths, its power of eliminating the bases being strictly a function of its silicon. The regularity of composition may be considered as fair only, due to the rapid changes of silicon in the metal, especially at higher temperatures. It offers certain economic advantages of cheapness, and ability to use certain classes of scrap inapplicable to cupola melting. Its use is extremely limited and there seems to be no points which should warrant any great increase in its use.

Its main advantage lies in the fact that the shop making a specialty of steel castings has at hand the required equipment necessary to make iron castings as a fill-in job. This is important, especially in locations far from the base of supply where an iron casting is often required in a great hurry for a breakdown job. Then, the shop making both iron and steel castings in the electric furnace is enabled to offer more regular operations with the great advantage of a hot furnace and a lowering of the overhead. That these points are appreciated is shown by the large number of foundries making steel castings, which also are engaged in the manufacture of iron castings as a side line.

For regular operations on iron the author cannot recommend the acid furnace, the basic process offering far greater advantages. This acid iron practice is given merely as a metallurgical aid to the shop which at any time may be called on for a heat of gray iron.

Melting Down

The furnace is charged in a manner similar to the practice in making a heat of steel, the charge consisting of a good grade of cast-iron scrap, with which may be mixed as many cast-iron borings or turnings as can be had. It must be remembered that a soft, high speed machinable iron, cannot be made in the electric furnace from any other class of scrap than that mentioned, with the one exception of pig iron, which is eliminated due to its prohibitive cost. Cases have been noted where soft, gray iron was made from a base of steel scrap, but the author worked on this problem for nearly two years, and found that while it could be made with certain reservations, its use could not be recommended due to the lack of regularity.

As cast iron has not the conductive power of steel, trouble may be experienced in obtaining an arc at the start of the heat, especially if melting a charge of 100 per cent borings. This offers no difficulty as the electrodes may be lowered until they are resting on the charge. The current will immediately begin its passage through the metal, and while there

will be no heavy load pulled, the result will be innumerable small arcs breaking throughout the furnace. The result of this, together with the heat caused by resistance, will be the formation of small pools of metal throughout the charge and as these increase in size, the load will pick up, and the bath will come down rapidly. If no load at all can be drawn, a small amount of coke, or an old piece of electrode may be placed over the top of the charge to draw the arc. The flame soon will melt the top layers of the iron together enough to form contact and the arc will pick up rapidly.

Consider Carbon Loss

As there will always be a slight loss in the carbon content on melting down, this must be counteracted by the addition of a small amount of coke added with the charge, 0.25 per cent carbon content being the average amount. This should be added about in the center of the charge so that it will be in the area of highest temperature, such a condition being favorable to maximum absorption.

As soon as the charge has melted, a metal test should be taken and poured in a sand mold. As soon as black this may be broken and judged by fracture or sent to the chemist for a carbon test. The fracture test is reliable, and while it does not denote the percentage of carbon, it does show whether the metal is soft enough for the average casting. If the carbon is of the proper percentage, the heat may be continued. If the fracture shows the heat is likely to be too hard, coke must be added and rabbled into the metal. Superheating the metal, and freedom from slag are the two main points to consider in raising the carbon content, a high temperature and low slag body favoring such action. The recarbonizer used should be of low ash content, and of sufficient weight so that it will not float too high on the surface of the bath, as charcoal for instance will do. Graphite flakes are excellent for such a purpose, as is a good grade of low ash coke or anthracite coal, as low in sulphur as can be had.

This fracture test also will show relatively the silicon content. This may require a slight addition. In this respect we encounter a peculiarity in that the melting point of ferrosilicon is above that of the iron. This addition will float on the surface of the bath until its character has so changed by fusion and combination with the iron itself that its melting point is lowered and absorption results. Therefore, it is imperative that no such addition should ever be made unless accompanied by sufficient carbon to assure a highly reducing atmosphere. The silicon need offer no difficulty as when the temperature of the iron becomes high, the slag may be slightly thickened when the silicon will be reduced into the metal from the silicon of the slag, in a similar manner to the action of a slag on a heat of acid steel, although not at all noticeable, except by the appearance of the fracture or the analysis of the chemist.

As soon as possible the carbon should be adjusted, that the finishing slag may be built. Such a slag is required to hold the heat in the metal and to prevent radiation to the refractories. This slag is made of sand mixed with lime, the lime consisting of 20 to 25 per cent of the mixture. Enough is used adequately to cover the metal. At first this slag may tend to lump, but as the temperature increases in the furnace, it gradually will melt, and by being rabbled occasionally will diffuse thoroughly and furnish the proper blanket condition. Considerable manipulation is required to keep such a slag in its proper condition. Due to the high silicon content of the metal, this slag is likely to thicken to a point where it becomes thick and gummy. The antidote to such a state of affairs is either a little lime, or limerock, carefully spread over the surface. Marble chippings, and oyster shells may be used to furnish the lime content and give fine service at a low cost.

Bring Up Temperature

The analysis of the metal being satisfactory, and its fracture appearance good, the next step is bringing up to temperature. Tests are taken with a standard spoon until the metal begins to lose its sluggish appearance. At this point, the iron rapidly is becoming superheated, and when it reaches a bluish appearance, it is hot enough to pour the most intricate castings. The heat is tapped and ordinary foundry procedure followed.

From this it may be seen that the melting of iron on the acid hearth is but a step in advance of cupola operations in that it allows of certain refinements, namely superheating and a slight adjustment of the chemical contents.

Re-elect Officers

Robbins & Myers Co., Springfield, O., operator of a gray iron foundry has re-elected its former officers. F. S. Hunting is president; Wilbur J. Myers, first vice president and secretary; Henry J. Sage, second vice president and H. E. Freeman is treasurer.

Purchasing Agents Give Varied Program

A comprehensive program, carefully worked out, yet sufficiently elastic to admit necessary changes at the last moment, has been planned for the forthcoming tenth annual Purchasing Agents' International convention and exhibition in Milwaukee, May 25 to 28 in the Milwaukee auditorium. The general convention sessions, opening Monday, May 25, will be held in Plankinton Hall with President A. G. Hopcraft, Cleveland, presiding.

The afternoon of the opening day will be given over to sectional meetings. In the evening, the specifications conference will be held together with a dinner at the Hotel Wisconsin, while the fuel conference, also a dinner meeting, will be held at the same hotel.

Tuesday morning will be given over to the second general convention session with a general discussion on scrap specifications and their value to all members. The session will then take up standard specifications, with Dr. A. S. McAllister, engineer-physicist of the United States department of commerce, as the principal speaker.

The afternoon session will again be given over to sectional meetings. George C. McClure, American Rolling Mills Co., Middletown, O., chairman of the National Iron and Steel committee, will preside at the iron and steel conference.

The usual order of business will be reversed on Wednesday, May 27, the morning being given over to the last of the sectional conferences, with the general convention session in the afternoon. In the morning the last meeting of the fuel conference will be held in Engelmann Hall, the public utility conference in room *A*, and the meeting of the oil company's buyers' group, with G. C. Pohler, Cosden & Co., Tulsa, Okla., presiding, in room *D*.

At noon, in conference room *B*, the new executive committee will meet for organization and the election of new officers. Announcement of the election of the new president and treasurer will open the general convention session in Plankinton Hall at 2 p.m.

The annual banquet in the Arcadia ballroom, at 6:30 p.m., with Thomas R. Marshall, former vice president of the United States, as the principal speaker, will close the day.

M. H. Beatty, formerly connected with the Brady Foundry Co., Chicago, has been appointed representative of the Hill & Griffith Co., Cincinnati, in the Chicago territory.

How and Why in Brass Founding

By Charles Vickers

Question Lead Additions

We are making roll neck bearings for sheet mills. These bearings do not have water running on them, as in the bar mills, and consequently get heated to between 500 and 700 degrees Fahr. The bearings now used are of copper 82 per cent; tin 8 per cent; lead 10 per cent, but are not satisfactory. Other mixtures were tried but they broke in a short time, and it is thought the heat weakens the bronze causing them to break. Would 15 per cent of lead weaken the bearings? They are well lubricated with a heavy grease.

When alloys of copper with tin are heated above room temperature, they rapidly and progressively lose strength and ductility. Thus the old familiar 88-10-2 alloy at 700 degrees Fahr., is only about one third as strong as it is at room temperature, and the elongation is practically nil. While some contend that the introduction of lead into such an alloy enables it to retain its strength at elevated temperatures, the fact remains that in point of strength such alloys leave much to be desired in that direction.

It is of course, the heat that weakens the bronze. The standard alloy for such service appears to be copper 80 per cent, tin 10 per cent, and lead 10 per cent. Possibly this alloy containing a little more tin would give better service than the one with 8 per cent tin. It is worth trying for the alloy is extensively used. The addition of more lead would not improve the strength of the bearings.

Metal Burns Into Cores

We experience considerable difficulty in casting heavy bronze pieces with cores, as the metal burns through into the cores and fills up the cored part with a mass of sand and metal which is exceedingly difficult to remove. We have tried silica cores and have painted them with a heavy coat of lead, but can not overcome the trouble.

Evidently, the cores are too open in texture. If the hot metal was to seep into the molding sand used to make the mold, there would be no semblance to a casting. This does not happen because the sand packs together leaving no crevices for the metal to enter. Silica sand is of no value as the grains fail to pack closely. All that is necessary is to have a thin veneer of fine sand on the outer surface of the cores, and the rest of the core of an open grade of sand well bonded. This type of construction will give at the same time maximum venting. Why not experiment to get a suitable facing sand for the cores? Cores made of two grades of sand are in common use. It would also be advisable to continue with the heavy coating of *lead*, but obtain the best grade possible, since it will save its extra cost in the cleaning room.

A Matter of Lubrication

We have been making bearings for hot rolling mills for many years using 80-10-10 alloy and have always put in a good grade of material, such as Lake copper or trolley wire with Straights tin and pig lead. Recently trouble has developed, due to the bearings cutting out at the neck when blotches of a dark metal would then show as though embedded in the bronze. We are told by the master mechanic this is slag or dirt in the brass, and we, therefore, send you one of these bearings so you may examine it and determine whether or not this is the fault of the material, or due to some other cause.

The difficulty is a common one in the case of such bearings and if this is the first time it has appeared, the makers of the bearings may consider themselves more than fortunate. The dark masses are iron and they come from the roll and not from the brasses. In other words the roll has been cut by heat, pressure and friction, and the direct cause of this cutting is carelessness on the part of those operating the rolls, since they have simply overlooked the necessity for lubrication.

The dark pieces in the bearings actually are embedded therein, and their identity as iron has been determined by analysis, and their presence is not due to any fault of the bronze, or to any neglect on the part of the maker, or the use of inferior material. In fact it would be extremely difficult to cast bearings with such inserts of iron, no matter how desirable they might be found. The bearing was running dry and the temperature rose to the point where the brass was softened and clung to the roll, but the latter was driven with sufficient power to continue revolving, so flakes of iron were wiped off and were crushed into the brass by the pressure. There is no remedy that may be applied outside of the ordinary methods of lubrication and that is strictly the business of the user of the bearing.

Bad Aluminum Castings

We are making flat castings of aluminum alloy for use as table tops, and find a lot of difficulty in eliminating shrinkage cracks, pits, and holes. We use all scrap aluminum, and make a heat by using 50 pounds of thin scrap such as dishes, tea kettles, wash basins and so forth, and 50 pounds of auto scrap. We melt this and then add 7 pounds of zinc. We find the castings shrink in the heavy parts around the risers no matter how large they may be reamed out. We use an advertised flux on the metal and supplement it with a small cake of magnesia and 2 ounces of sal ammoniac. The castings are porous and dirty.

To cast a flat plate in aluminum alloy is anything but an easy matter when using the best of aluminum alloy. However, with the quality of metal mentioned, unless this table top is for children's toys and consequently small in size, one may be pardoned for doubting whether the job may be accomplished. The 7 parts of zinc will not be found helpful or is it essential and there is a possibility that better results would be obtained by omitting it entirely; try a heat without the use of zinc and carefully note results. If the results are no better than before, it would be advisable to discard the use of scrap metal on this particular casting, and make an alloy by melting 92 per cent of pure ingot aluminum and adding 4 per cent each of copper and silicon. This alloy will not crack like the scrap now being used. It is necessary to purchase two hardeners; one consisting of 50-50 copper aluminum, the other of 50-50 copper-silicon. Melt eight pounds of each of these hardeners together with 84 pounds of pure aluminum ingot. Do not pour any hotter than will flow the casting. The metal should be a dull red color at time of pouring.

Bill Learns Something from Jim and E. A.

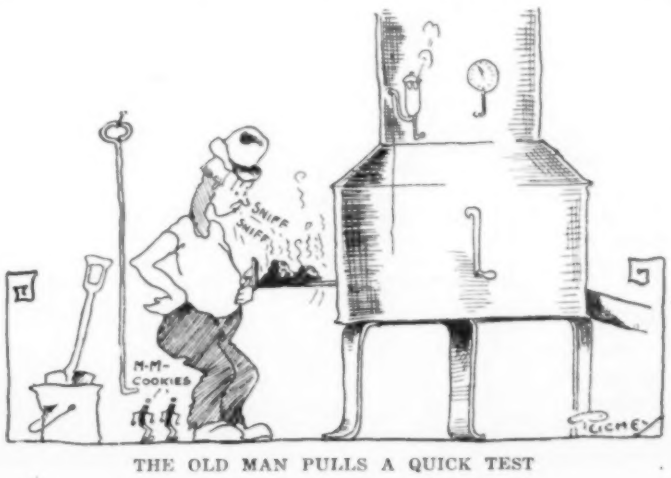
BY PAT DWYER

SOME day when I have the time, also the necessary inclination I intend to consult one or more competent authorities with a view to determining why a person derives a certain measure of melancholy pleasure in dwelling on past troubles. For example, what uncontrollable impulse forces a man to send his tongue on an exploring expedition into the cavity formerly occupied by an aching tooth?

When a molder finds himself with an unexpected free day on his hands, why does he visit a strange foundry and prowl around for an hour or two instead of remaining peacefully at home or going for a rejuvenating jaunt into the great open spaces?

At various times when perhaps I might have been engaged to better advantage I have given this subject serious consideration, but up to the present I have failed to arrive at a satisfactory solution to the problem. Offhand I am unable to say whether the failure rightfully should be charged to native inability to tackle problems of that character, to the inherent complexity of the problem itself or to lack of proper application. Some day, as I said before, I am going to look into the thing real earnestly and satisfy my mind on the subject. The objection quite properly might be raised that even if I do solve the problem, I will be no better off and the sum total of human knowledge will not have been increased one iota. Strictly among ourselves I never have seen an iota and only have the haziest notion what it means, but since the term is used quite freely both in the written and spoken form, I presume the average hearer or reader derives some meaning from it.

Sometimes a man may visit a foundry for professional reasons and on these occasions the visit may be prompted by a natural desire to see friends and acquaintances and exchange local gossip in connection with the trade and maybe other topics. It is *so* hard to hold a conversation in one steady groove for any length of time. Probably you have noticed that in your own experience. You start off nobly with a reference to the ruinous prices prevailing for castings and before half an hour has elapsed you find yourself mixed up in an acrimonious debate touching on whether Mr. Ruth will or will not equal his last year's batting average. Where the party of the first and the party of the second part discover to their mutual delight that they graduated respectively from dear old Podunk and Rah Rah Rhyolite Tech in the class of '02, the conversation becomes so intimately touching and sentimental that innocent third parties who happen to be present invariably are moved to tears. Instances are on record where some of the more demonstrative third parties have been seen biting large hunks from test bars in an effort to control their feelings at these seances.



THE OLD MAN PULLS A QUICK TEST

Last Wednesday afternoon a mutual friend of Bill's and mine blew into town and came to see me. He intimated he was leaving again in the evening and suggested that both of us should go out to the foundry to see Bill. The idea appealed to me in more ways than one, but just to test his sincerity I stated we were quite comfortable where we were, the visit involved a fairly long ride, the telephone was there on the desk and he could call Bill and easily exchange the compliments of the season and all that jolly old kind of piffle.

He objected vigorously and promptly turned down the entire program. He said he did not believe in this long distance stuff. He pointed quite logically to the fact that he did not have a chance often to visit some of his old time friends. When he did get a chance he wanted to shake them by the hand and talk face to face. He added, quite unecessarily I thought, that was the kind of a little guy he was. Absent treatment, he declared might suit some people, but he was unalterably and unequivocally in favor of direct action. "What's the matter with you?" says he in surprise. "I can remember the time when you were not so keen to keep the old nose on the grindstone. You usually were the first lad over the fence. I suppose you have forgotten the time you quit Joubert & Goslin's in Birmingham because you did not get first iron one night. When the gaffer asked you in surprise why you were drawing your time you told him you had weak

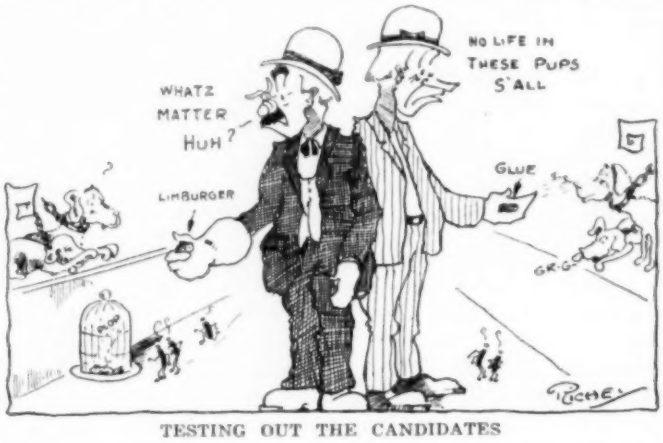
eyes and the sight of the bottom dropping gave you a headache. Har, Har, you were just about as subject to headaches in those days as a Missouri mule. C'mon, let's go!"

We went.

We found Bill out in the yard holding an inquest over a short piece of pipe that had been returned from the machine shop marked offensively *N. G.* The flanges had been faced at both ends and the pipe apparently was a satisfactory casting. Answering our natural inquiry, Bill said the pipe had leaked under pressure at a point on the cope side where the flange joined the main body. He wasted no time in idle speculation, but instructed one of his huskies to knock the flange off with a sledge hammer. The fracture disclosed a porous area sprinkled with small blowholes. "There y'are," said Bill. "I am going to have a few intimate words with the coremaker who made that core. In spite of all the instructions I give those birds they will insist on putting too much binder in the sand, then they ram it as hard as a rock and to make a complete job they waste their time slicking the surface with a trowel. The end and aim of their existence is to make a smooth, hard core that will look good and stand handling. The fact that a core is only a means to an end and not a finished piece of merchandise calmly is ignored. They think their mission in life is fulfilled when the core safely is anchored in the mold. What do they care whether or not the iron will lie quietly against it?

"If I dragged that lad out here now and showed him the casting he would swear by the shade of his sainted aunt Maria that the core was made strictly according to Hoyle and was in perfect condition when it left the coreroom. Further he would claim that the vent was not lighted until after the casting was poured and *any* person should know that was a fatal oversight. If I should pin him in a corner by producing the boy who had held a skimmer to the vent from the time pouring commenced until the gas had ignited, he would hop nimbly to the old standard alibi and claim the iron in the ladle was wild and full of gas.

"I know better now, but for many years I also accepted the old occluded gas theory for the presence of blowholes in a casting. Under extraordinary melting conditions, the iron may become oxidized and as a result the casting will be filled with pinholes, but these conditions are rare and I have found that nearly all blowholes may be traced to one or more features in the mold or the core. Iron will not lie quietly against a hard or wet surface and the boiling action produces steam that chills the metal and traps some of the bubbles. Frequently the violent action exerts an erosive action on the sand and carries some of it away. The chilled metal and the dirt unite and the mess sticks to the first convenient point of the mold with which it comes in contact.



TESTING OUT THE CANDIDATES

"During my investigation of this subject I consulted various foundrymen competent to render an authoritive opinion and was greatly encouraged to find I was on the right track. Among the opinions received was a written treatise from my old friend Jim Murphy. He covered the subject in such a comprehensive manner and presented his arguments in such a charming literary style that I have preserved the manuscript. If you will be kind enough to step into the office for a moment I will be glad to show it to you."

We adjourned to the foundry office where Bill set out the chairs and a handful of stogies and then proceeded to read the following scientific paper which he fished out of one of the drawers in his desk.

DEAR BILL:

By a curious coincidence when your letter arrived I was just recovering from a mild attack of that tired feeling induced by an earnest effort to absorb a deep and profound theory presented in a recent issue of THE FOUNDRY on the subject of adsorbed gases in their relation to porous castings. Some one always is trying to drive the poetry out of foundry industry by inventing or trying to invent new diseases apparently for the simple and altruistic pleasure to be derived from presenting a theoretical remedy for a purely imaginary condition. 'Tis a sad commentary on our boasted progress to find up and coming young lads threshing over old straw from which every vestige of wheat was winnowed, as Sandy McNab might say, *Lang syne.*

In this connection I am reminded of the practice of one of my old preceptors. At the time I considered it the height of absurdity, but in the light of recent disclosures I am forced to the conclusion that perhaps I was rather premature. In the new school the practice probably would be regarded as representing the pinnacle of wisdom. A highly developed sense of smell either inherited or acquired was the only essential factor required. Probably the only reason the practice did not receive wider recognition was because the sense of smell in the average foundryman is represented by a minus sign. Constantly inhaling core smoke and the ordor of sour paste gradually paralyzes the olfactory nerves even before the nasal passages become coated with a deposit of dust, soot and plumbago. In the balmy days of my apprenticeship when the well known *tempus* fugited merrily on the wings of pleasure and when *memento mori* was relegated to the far off and indefinite future, an old New England foundryman did his duty manfully in an attempt to keep my nose on the grindstone 10 full hours a day. In the brief periods when, occasionally, I came up for air, I had an opportunity for watching him performing some mysterious and highly interesting rites. I never discovered whether it was a gift or if he used a mechanical or chemical process, but of a certainty there was nothing the matter with *his* nose. Smell? Say, that old bird could have held a job in a tea factory.

I marveled at the time and have had no occasion to change my opinion since until I read the article in THE FOUNDRY at one of the peculiar habits, methods, processes or whatever word is most appropriate in which he indulged this handsome gift of his.

Shortly after the slag commenced to run from the cupola he dipped the end of a rod in the pool and collected a lump of slag on the end something after the manner of a glass blower when he dips the end of his tube into a pot full of molten glass. He plunged the slag into water to cool it and then daintily sniffed at it several times from various angles. Finally he held it close to the old beak and took a good, long, satisfying smell, for all the world like the fadeout scene in a modern movie thriller. On this simple test he decided whether the cupola was or was not working satisfactorily. He claimed he could tell with the greatest nicety of precision exactly how the old girl's digestive apparatus was working by this elementary expedient.

Gleaning in a general way and to the best of my limited ability from unabridged works of art of an ethenological character I have gathered that absorbed gases are something of a mysterious character taken into the body from the outside. Whether they

exist in the form of molecules or microbes deponent sayeth not. Also it seems to be a debatable point whether they are communicable or infectious.

Leading authorities are fairly unanimous in declaring their effect on the skin of a casting is similar to that produced on the human hide, beg pardon, human epidermis, by an attack of measles or prickly heat. Further, according to the opinion of those who have studied the subject deeply, inside and outside influence are contributory factors to their appearance. One feature stands out prominently in my memory and that is few bad castings, porous or otherwise were made in the old boy's foundry.

In view of the foregoing I am thinking seriously of presenting a paper at the next foundrymen's meeting on the addition of a small terrier to each foundry force. These alert little canines easily could be trained to give proper warning when these deleterious gases make their appearance and preventive measures promptly could be adopted. Anticipating objections that undoubtedly will be raised by those who have not given the subject serious consideration, I want to point out in advance that instances are on scientific record of canaries and even lowly mice having been utilized on many occasions to detect obnoxious gases fatal to the life of human beings.

If these dumb little creatures can be trained I see no reason why such a highly intellegent creature as a terrier cannot be trained to detect and report the presence of absorbed and other deliterios gases responsible for loss of so many castings. The human proboscis, as I said before, usually is not capable of detecting a faint and elusive odor in a foundry, but a dog—say, a dog simply would prove invaluable. Also at this point it may be appropriate to intimate that a dog can be trained in less time than a chemist and the subsequent operating expense and overhead are in no manner comparable.

The course of training and the character of the signals may be varied to suit local conditions, but as a tentative program I suggest that the dog be trained to howl in the presence of adsorbed gas, bark to indicate the absurd variety, growl for absorbed gas, snarl for occluded gas and wiggle his little stub tail in delight when innocuous gas makes its appearance.

However, I beg to direct attention to a possible source of danger in placing the system in operation. Many of our foundries today are operated in fair imitation of insane asylums and the probability always exists that the innocent little messenger of science may contract hydrophobia.

In any serious attempt to cure adsorbdity in castings, serious consideration should be given to the moisture in the sand. The amount should be carefully determined by evaporation or other suitable means and filtered if necessary. The molders' hands should be examined for warts and callouses and his head for vacuity. Manicuring the nails is optional.

If the foregoing suggestions diligently applied do not cure porosity in castings caused by adsorbed gases, the only remaining remedy with which I am familiar is to steep them in a bath of noodle soup at a temperature of approximately 476 Fahr.

Yours,
JIM.

"There y'are" said Bill, "A masterly presentation. All summed up neat and ship shape, Bristol fashion with no loose ends trailing. Jim knows his stuff.

"I had comments from several other sources, but as they all supported my own opinion I simply will read one from Edgar A. Custer who was moved to take his trusty and well trained pen in hand upon reading the article in THE FOUNDRY to which Jim refers. Ed has done some, Oh! yes quite some, experimenting in his time with molds permanent and otherwise and has tracked many an occluded gas to its lair. He wrote me as follows:

DEAR BILL:

One by one my fond illusions are being shattered. I always thought that hot iron was especially desirable, nay, essential to the production of perfect castings. I have been laboring under the impression that it kept down gas and blowholes and that a cleaner and better casting could be made from such iron than if it was poured on the cool side. Now I find I have been mistaken all these years.

Occluded gases are waving their threatening fists at the poor unfortunate foundryman. More occluded gases are present in hot iron than in the cooler variety and as the casting cools they cease to be occluded and become gas holes. Now isn't that one hell * of an alibi for wet sand, poor ramming and irregular pouring? I wonder if the author of the article is not confusing disassociated air trapped in pouring with the inherent and innocous occluded gases which however harmful they are in steel, are not in evidence in cast iron.

My experience proves conclusively to my satisfaction that any iron which gives off gases, occluded or any other kind when in the molten state is not a fit iron to pour into castings. When a casting discloses gas holes or sponginess, the foundryman is on the wrong track when he attempts to lay the blame on the iron. He always can find the trouble on the floor. The remedy easily is applied provided he uses ordinary common sense, normal foundry iron and pours his metal hot.

Respt.
E. A. C.

Bill slipped the papers back into his desk and then wanted to know what we thought of the theories presented. I told him that I agreed in the main, but I was skeptical about the dog feature. Dogs probably have a place in the general scheme of creation, but ever since a big black Newfoundland brute had raced through one of my floors of open sand molds one day, I felt their place was not in a foundry.

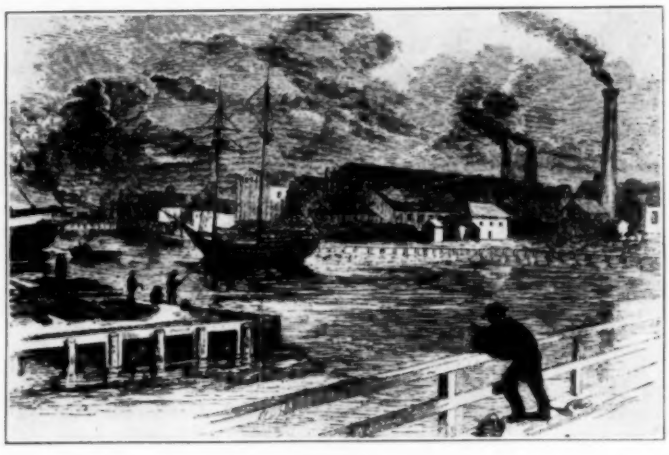
"Well, of course" said Bill. "Tastes differ. Did you hear the story of the dog in the police court? When the time came to swear one of the witnesses the Bible could not be found. In answer to an angry query from the judge one of the attendants tremblingly confessed that the police dog had eaten it. 'Let the witness kiss the dog then' says his honor. 'This court cannot be held up all day on a technicality.'"

* A technical term occasionally employed in the foundry to indicate emphasis, or what have you?

THE YODELER IN THE REAR THINKS THE BEAST IS AN ALPINE CHAMOIS LEAPING FROM CRAG TO CRAG

Traces Cannon Manufacture-I

Greatest Progress Made in Last of Three Epochs in History of Cannon Manufacture



By
Job Goostray,
R. F. Harrington,
and M. A. Hosmer

Fig. 1—Alger's Iron Foundry from the South Boston Bridge

AMONG the great industries of New England, the manufacture of iron was the first to receive attention. Iron ore in considerable quantities was known to exist within the territory of the Massachusetts Bay colony; and as early as 1629 some steps appear to have been taken toward the manufacture of iron by the court of assistants in London, under whose patronage the colony was founded. During the next 10 years, deposits of bog ore were found in numerous ponds in the Plymouth colony; and, in 1652, iron manufacture was begun at Raynham. The *Old Colony* was known as the main seat of this industry in New England, out of which grew a concern which was later to become one of the principal manufacturers of cannon for the United States government, the South Boston Iron Co., which is the present Hunt-Spiller Mfg. Corp., South Boston.

It is possible to trace a few of the steps whereby New England's part in the ordnance manufacture came about, and to show what part this industry has played in history. A short review of the progress of guns through the several ages is interesting, and perhaps will serve to connect primitive methods of destruction with medieval and modern industry.

Ever since organized warfare played any part in history, mechanical appliances have been used for throwing projectiles, and "engines invented by cunning men to shoot arrows and great stones" are mentioned in the Old Testament. However, the history of the gun or cannon, as we think of it today, is properly divided into three epochs.

The first epoch was from 1313 to 1520, during which period a material resembling gunpowder was used as a means of propelling the shot, which at that time was nothing but stone. Although the manufacture of bronze was well advanced at this point in history, most of the large-sized guns were made of wrought iron, which was a cheaper material. The second epoch, from 1520 to 1854, in which the propelled material was made from cast iron and the cannon were of bronze or of cast iron, passed with little actual progress. The third epoch, from 1854 to present time, is marked by tremendous progress. The round cast iron ball has given way to elongated projectiles of steel and cast iron, and the era of rifled guns practically dates from the beginning of this epoch.

SINCE the dawn of history, man has tried various mechanical appliances for throwing projectiles, the first cannon, resembling in principle the gun in use today, being made early in the fourteenth century. In this paper, which was presented at the New York meeting of the American Institute of Mining and Metallurgical engineers, held in February, 1925, the authors have given a brief history of metallurgical practice in cannon making with particular reference to the cast iron gun. The authors are connected with the Hunt-Spiller Mfg. Corp., South Boston, Mass. Mr. Goostray formerly was foundry superintendent, now retired, Mr. Harrington is metallurgist and Mr. Hosmer is chemist in the metallurgical department. The article will be published in two sections, the second installment appearing in an early issue.

The actual date and place of the making of the first cannon is a subject of much controversy and research. However, "the earliest known representation of a gun in England is contained in an illuminated manuscript *De Officiis Regum* at Christ church, Oxford, of the time of Edward II, 1326. This clearly shows a knight in armor fixing a short primitive weapon shaped something like a vase and loaded with an incendiary arrow. This type of gun was a muzzle loader with a vent channel at the breech end. . . . These fire arrows were evidently small, as only 2 pounds of gunpowder was provided for firing 48 arrows, or about 7/10 ounces for each charge."

Two guns left by the English after the siege of Mont St. Michel in Normandy, in 1423, were made of wrought iron and the larger had a bore of 19-inch diameter. Bronze guns made of two pieces screwed together and weighing about 18½ tons were known to be cast at Constantinople in 1468. The front portion of these guns had a caliber of 25 inches and was made for stone shot weighing about 675 pounds. These were used later against Sir John Duckworth's squadron when the Dardanelles were forced. In this engagement six men-

of-war were damaged and about 126 men were killed or wounded.

During the sixteenth century, with the introduction of iron projectiles, which enabled the use of smaller caliber, bronze guns came into great favor. They first were cast in England in 1521 while iron cannon were cast there first about 1540, foundrymen from other countries going to England to teach the art. Richard Moldenke says that a certain Thomas Johnson is mentioned as having cast 42 3-ton "great pieces of ordnance for the Earl of Cumberland, in 1595 . . . " and at the time of Queen Elizabeth, England actually exported guns to the Continent. The bronze guns at that time, although smaller, were long. Particular mention is made of one at Utrecht in 1544, which was presented by Charles V to Henry VIII. It was 24½ feet over all in length, and the caliber was only 4.75 inches.

Up to about the first of the eighteenth century, guns were cast hollow, and there appears to have been no attempt at standardization or classification. About 1739, when the boring of guns from the solid was introduced by Moritz, of Geneva, uniformity of caliber naturally followed. During the eighteenth century little change was made in principles of construction. Guns were made smaller and were strengthened, and much progress was made in standardization and methods of manufacture of gunpowder. In the earlier periods, the explosive often was mixed on the fields; it burned slowly, and never was to be depended on.

Steel Considered Unsafe

During the first part of the nineteenth century, cast iron was the only metal considered suitable for large guns, while bronze was used largely for field guns. Steel guns were attempted but, as they had no way of forging large quantities of steel, the armor had to be welded to obtain sufficient material for one gun. The art of welding had not been learned, hence steel guns were apt to fly to pieces suddenly and were considered too treacherous to use. We learn from some of the investigations of old guns, especially in connection with these earlier steel models, that their failure probably was due to lack of knowledge in gun designing rather than to poor material.

"However, a certain Peter Townsend of Noble Townsend & Co.[1] is said to have produced in 1776 the first steel made in the province of New York, at first from pig and afterward from iron in the German manner. His son, the second Peter Townsend, was supposed to have made in 1810 the first blister steel produced in the state of New York. The latter did much to improve the manufacturing of his day and early made use of the anthracite coal in the blast furnace."

The Sterling Iron Works, Orange county, New York, was prominently connected with iron manufacture during and immediately following the Revolutionary war. The anchors for the first United States ships of war were made there, including those of the United States frigate CONSTITUTION. Perhaps its greatest achievement was the production of a great chain which extended across the Hudson river to prevent British ships from getting up to Albany and thence within easy communication with Canada.

Another plant of some importance was the Orange factory at Arden, operated by Cunningham Bros. During the war of 1812, cannon balls were produced for the American forces and the Cunninghams were permitted to keep 12 men exempt from military service.

An important part in the vast metallurgical progress of the nineteenth century was played by Cyrus Alger, who was born at Bridgewater, Mass., in 1781 and died at Boston in 1856. He followed the trade of his father, who was a foundryman. In 1809, he specialized in ordnance work and founded a foundry in 1810, which was incorporated under the laws of Massachusetts in 1827.

His business at first was that of a general jobbing foundry, but he soon made valuable inventions applicable to his trade, among which was an improved method of casting chilled iron rolls, by which the part subject to wear was of increased hardness. He discovered a way to purify cast iron, which gave it a strength nearly threefold that of ordinary iron castings which was of immense value to the manufacturers of cannon and heavy artillery. The cannon he made were put to extreme test and rarely failed. During the war of 1812 he cast large quantities of cannon balls for the government.

Mr. Alger introduced the use of anthracite coal for melting iron in the vicinity of Boston, and adapted his furnace to its use. He made a change in the reverberatory furnace for melting iron, by reversing the incline of the hearth to cause the molten metal to flow toward the flame where the heat was most intense.

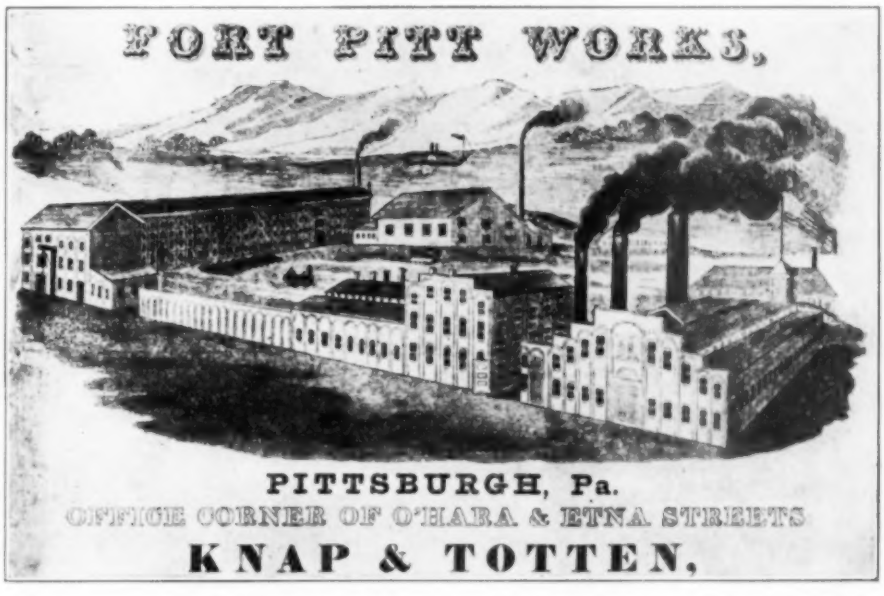


FIG. 2—THE FORT PITT IRON WORKS FOUNDED IN 1803 AS THE PITTSBURGH FOUNDRY CAST THE FIRST GUNS BY THE RODMAN PROCESS IN 1849

New Firm Incorporated

The new firm incorporated in 1827 as the South Boston Iron Works, began the manufacture of iron ordnance in 1828. Alger's method of purifying cast iron gave the company an advantage in making iron guns, especially those of large caliber. This process consisted primarily of melting the original metal in a reverberatory furnace known as an *air furnace*, allowing the metal to remain in fusion for an extended period of time, or casting and remelting the same until such time as the refining action gave the desired physical properties. These were measured largely by the increased density obtained.

In 1834, Alger made the first rifled

[1] Orange County Ironmaking, *Iron Trade Review*, July 31, 1924.

cast iron gun in the United States and during the next year commenced the manufacture of the first malleable iron guns. He later supplied many of these to the government. One invention followed another, among them the covering of a fuse hole on the inside of the shell with a wafer of lead. This cover had to be removed before the shell was fired. He manufactured the first bronze guns for the United States navy, heavy artillery and also for the state of Massachusetts.

In 1842, the Columbiad, then by far the largest gun cast, was turned over to the government by the South Boston Iron Works and a report to the ordnance board of the United States war department said that the cannon furnished by this company afforded the most favorable results, and that the quality of the metal was unsurpassed. It was of 12-inch caliber and had a range of more than 2 miles.

Mr. Alger had a son, Francis Alger, who succeeded him and who added more to the importance of the company. The younger man was scientifically inclined. He wrote a valuable book on mineralogy and had the finest collection of minerals in the country, brought from all parts of the world. He was elected a member of the American Academy of Arts and Sciences and received an honorary degree from Harvard university. He was also a member of the Boston Society of Natural History and for several years its curator of minerals. Francis Alger was often called to Washington in the interest of his many inventions and of his company, and died there on Nov. 27, 1863, while engaged in testing shells.

Cyrus Alger made many inventions and improvements in metallurgical science which were valuable to the government and became the basis of the great advance in metallurgy which continued throughout the latter part of the century. Admiral Dahlgren once said of Mr. Alger, "He possessed that rare quality, sagacity, which constitutes in truth the highest attribute of the intellectual man, and enabled him to arrive at results which others sought by disciplined study, and often in vain." His process whereby irons of different analyses were put into the furnace charge and treated in the furnace, the resulting iron being cast in pigs and known as remelt iron, is familiar to all foundrymen of today.

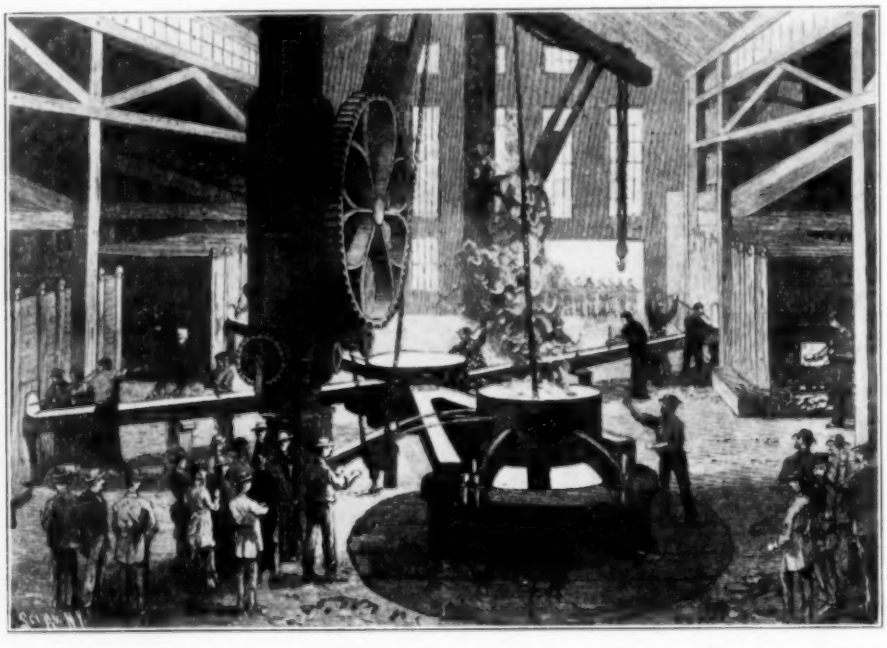


FIG. 3—CASTING A GREAT CANNON AT THE SOUTH BOSTON IRON WORKS IN 1884

In a report to the ordnance department on April 2, 1844, Major Wade, of the United States army, shows some of Mr. Alger's work in making tests on heating the melted iron for different periods of time, which were carried out at the Alger plant, South Boston Iron Works. Some of the results obtained were as follows:

	Strength Pounds
Casting made as pig was melted	6,506
Iron in fusion 1 hour	7,316
Iron in fusion 2 hours	8,256
Iron in fusion 3 hours	8,378

The above shows a gradual and positive increase of strength as the iron continues in fusion for longer periods of time. The reports also conclude that high temperatures make for soundness and greater strength. Although the transverse strength most generally is measured, when the quality of different metals is compared, it is believed that a more accurate measure may be found in the tensile strength. Some of these figures are interesting in this connection:

	Density	Tenacity, pounds
Guns cast prior to 1841	7.148	23,636
Guns cast in 1851	7.289	37,774
Samples from 10-in. Columbiad, 1851	7.304	45,970

The first of the large cannon of 10, 11, and 12-inch caliber, for the United States government, were cast at the South Boston Iron Works under direction of Mr. Alger, the latter selecting the iron and using his own process. One of these guns, 11-inch caliber, carrying a solid shot of 170 pounds or a shell of 135 pounds, was fired 655 times with the former projectile, and 1306 times with the latter, an enormous endurance of 1959 rounds before it failed. This far exceeded any other record of the ordnance department from this or any other country.

This process thenceforth was used largely for gun castings; hence the metallurgical term *gun-iron* was applied.

Use Charcoal Iron

The foundries casting ordnance between 1840 and 1850, in addition to the South Boston Iron Works, were the Fort Pitt foundry at Pittsburgh, Pa. and the West Point foundry at Cold Springs, N. Y. These foundries were using charcoal iron for gun castings which was obtained from the Greenwood furnace near Cold Springs, N. Y., Franklin Smelting furnace, New Jersey, the Ammenia furnace and the Richmond furnace, Richmond, Mass.

The process whereby guns were cast solid and bored out still continued. However, the exterior usually became chilled during the cooling process by sudden contact with the mold and was converted into a solid crust before the interior dropped to the melting temperature. The solid gun frequently consisted of various strata of different densities, and although great care was exercised it was not unusual to find a spongy portion consisting of incoherent crystals so loose that dark cavities could be seen with the naked eye. A sharp-pointed steel chisel could be driven easily into the spongy portion. It was not until Lieutenant Rodman developed a process that extreme endurance service was obtained with guns manufactured from cast iron.

Thomas Jefferson Rodman was born at Salem, Ind., July 30, 1818. He was a West Point graduate and served in the Mexican war, but soon showed such skill in devising guns and am-

munition that he was detailed to that work.

In 1849 he invented a process for casting hollow cannon using a core around a tube. Water ran in through a pipe in the inside of the tube to about 5 or 6 inches from the bottom, the tube having a closed end to prevent leakage. The water circulated to a side outlet near the inlet, the supply being sufficient to keep the tube cool. Hence with the inner portions of the casting cooling and solidifying first, they were compressed and supported by the contraction of the exterior when it cooled. The casting was further secured from irregular or excessive strains by building a fire around the flask to keep it hot and to give uniform cooling. About 24 hours after casting, the arbor was removed and a pipe was put in the bore of the casting that was formed by the core, and water was kept running until the casting was cold.

Most of Rodman's work was carried out at the arsenals at Pittsburgh, Watertown, Conn., and Rock Island, Ill. At the last named, he was in command from 1865 until his death on June 7, 1871. He rose to the rank of Brigadier General.

The first guns made by his process were cast at the Fort Pitt foundry, Pittsburgh, on Aug. 4, 1849. They were two 8-inch Columbiads. Some of the experimentation connected with the manufacture of these guns and also the manner in which they were tested are described in detail by Rodman in his reports. The two molds were placed side by side in a pit and the iron charged in two air furnaces, each containing 14,000 pounds of the same kinds of iron. After melting, the liquid iron remained in the furnaces 1 hour exposed to a high heat and then was discharged by separate streams into a common reservoir. From the reservoir it issued into a single stream, which after proceeding a few feet separated into two branches, each leading to a separate mold. Both molds were filled at the same time; one was cast solid, and one was cast hollow and cooled by the Rodman process. The testing of the guns commenced Sept. 7. The one cast solid stood 85 fires; the one cast hollow and cooled by the Rodman process stood 251 fires. The density of the iron used was 7.223; the tenacity, 27,488 pounds.

Again, two 8-inch guns were cast July 30, 1851. The iron was made at Greenwood furnace, New York, and was 36 per cent of No. 1, 25 per cent of No. 2, 39 per cent of No. 3. The iron was melted in two furnaces; 12,500 pounds in one and 15,500 pounds in the other, nearly ¾ being of second fusion, ¼ third fusion, and the remainder fourth fusion. After melting, the liquid iron remained in the furnace 2½ hours exposed to a high heat. It then was discharged by separate streams into a common reservoir. At the same time it was withdrawn from the reservoir in a single stream. After proceeding a few feet, this separated into two branches leading to separate molds, and filled both molds at the same time. One of the castings was made solid and cooled in the usual manner. The other was cast hollow and cooled by the Rodman process. A fire was kindled in the bottom of the pit directly after casting and was continued 60 hours. The pit was covered and the iron flask containing the mold was kept at as high a temperature as it would safely bear.

The testing of these guns commenced Aug. 28, and continued until Oct. 22. The one cast solid stood 73 fires and the one cast hollow stood 1500 fires. The density of the iron used was 7.287; the tenacity, 37,811.

Three Air Furnaces Used

Two 10-inch Columbiads were cast Aug. 21, 1851. Greenwood iron of the same qualities as melted for the 8-inch guns were used. About one-ninth consisted of first fusion; five-ninths of second fusion; and one-third of third fusion. It was melted in three air furnaces containing 12,000, 15,000, and 19,000 pounds. The liquid iron remained in fusion 2¼ hours and was discharged from all the furnaces at the same time into a common reservoir, from which it issued in a single stream. After proceeding a few feet, it separated into two branches, leading to separate molds, both filling at the same time. Both molds were placed in the same pit. One of the guns was cast solid and the other was cast hollow and cooled by the Rodman process as described above. All of the space within the pit outside of the molds was filled with molding sand and rammed. This was done because the iron flasks were not large enough to admit the usual amount of sand in the walls of the mold.

It was apprehended that the heat of the great mass of iron within would penetrate the thin mold and let the iron run out; consequently the exterior of the mold of the 10-inch hollow gun, instead of being exposed to the heated air while cooling, as was the case with the 8-inch hollow gun, was surrounded by green sand, which caused a more rapid cooling of the exterior surface of the casting. Water was passed through the core arbor at the rate of about 30 gallons per minute for 94 hours. At the end of the period, an attempt to withdraw the core arbor proved unsuccessful; the contraction of the iron around it held it so firmly that the upper part of it broke off, leaving the remainder imbedded in the casting. The stream of water was then diminished to 15 gallons per minute, which continued to circulate through the arbor for 48 hours.

The testing of these guns was commenced Oct. 7 and ended Oct. 18, 1851. The one cast solid stood 20 fires; the one cast hollow and cooled by the Rodman process stood 249 fires. The density of the iron used was 7.292; the tenacity, 37,817. Extracts from the reports of experiments on the strength and other properties of metals for cannon, government report 1856, are as follows:

It will be seen that the endurance of the guns cast hollow surpasses those cast solid in every case where both were cast at the same time and from the same material, the difference in one case being more than 20 to 1, and the aggregate of all, more than 11 to 1. This great difference occurring in every instance where guns were cast and tried in pairs could not, it is believed, have been caused by any accidental circumstances, for the methods pursued to insure an exact equality of material in both guns of each pair and for preserving an exact uniformity in the proof of each, seem to forbid the supposition that any unknown inequalities could have existed, either in the casting or the proving of the guns. The great difference of endurance must therefore be ascribed to the different methods by which the castings were cooled, and to those above.

It also will be perceived that in the several pairs cast solid and hollow, the actual strength of the iron in each gun of the pair as measured by the testing machine remains the same, while the strength of the guns in the same pair, as measured by the fires endured, differs greatly. From this it appears that the difference in the methods of cooling the casting, while greatly augmenting the strength of the gun in one case does not impair or affect the strength of the iron. For these and other apparently discordant or incongruous results, we must seek an explanation in the laws which govern the contraction of iron when cooling. It is known also that the contraction under equal reductions of temperature is different in iron of different qualities; soft gray iron, that which contains a high proportion of carbon, contracting least; and that which founders term high, which is light and close grained and contains the least percentage of carbon, contracts the most. Other circumstances being equal, the contraction of the same iron is greater or less according to the greater or less rapidity with which it is cooled. That which is cooled most rapidly contracts most. Every experienced founder is aware of this and endeavors so to proportion his patterns that all

the parts of the same casting may cool equally.

A convenient method for determining the condition of the iron while in fusion, and whether it has arrived at the proper condition for casting or should be longer in fusion, is found in dipping from the melted pool of iron and casting into small bars 10 inches long, 2 inches square at the top, down to ¾ inch at the bottom in a step form in four sections. They are cast open in green sand and allowed to remain in the sand 10 minutes, then taken out and cooled carefully with water, then broken at the different places and the condition of the iron judged by the several fractures. These fractures will exhibit various aspects from white at the small end to a mottled in the middle, and to a dark gray at the large end; and a practiced eye will soon be able to mark the process of the changing quality of the iron and to determine the proper time for casting the gun.

Alger made a 12-inch Columbiad in 1842, and subsequently the original experiments resulting in the famous Dahlgren *shell guns*. Mr. Moldenke says that between the years of 1862 and 1877 alone, no less than 272 Rodman guns, of which 103 were of 15-inch caliber and weighed about 50,000 pounds apiece, were produced at this establishment.

The Dahlgren gun was a gray iron gun and was designed about 1840. It differed from the Rodman gun in that it was cast solid, cooled from the outside, and bored out. Both were smoothbore guns and each was named from the officer who designed it—Rodman of the army and Dahlgren of the navy. W. P. Hunt states that the 11-inch Dahlgren gun carried by the MONITOR in her fight with the MERRIMAC and the guns of the same type which sunk the ALABAMA were made at the South Boston Works.

Making Die Castings of Nonferrous Metals

(*Concluded from Page* 396)

is acted upon easily by the elements of the plating bath, it is necessary that the entire surface of the part be covered instantly with a protecting coating of metal. For this reason the initial voltage should be as high as possible, without burning the deposit, usually 4 to 5 volts and then reduced to 2 to 3 volts for the remaining period of the plating operation.

Die casting equipment consists of a container for molten metal capable of withstanding high pressures, a die or mold into which the molten metal is forced, and a suitable frame for opening and closing the die. Casting machines are divided into two general classes, namely air machines, and plunger machines, depending upon whether the metal is forced in by air, or by a mechanical plunger.

Fig. 4 shows a plunger type casting machine. The metal is forced through the nozzle of the pressure cylinder by means of a plunger actuated by an air cylinder through a connecting rod and rocker arm. The pressure cylinder is submerged in a pot containing molten metal. When the plunger is in the position indicated the metal flows into the pressure cylinder through a slot at the bottom, and is ready to be delivered to the die on the next stroke. The die is mounted on a suitable frame, not shown, which swings into position, so that the gate registers with the nozzle of the pressure cylinder.

Use Air Pressure

Fig. 5 shows an air type casting machine. The pressure pot known as a *gooseneck* is supported on suitable links which permit it to be submerged in the metal pot after each casting operation. The metal flows into the gooseneck through the nozzle, thus charging it for the next casting. When locked against the nozzle seat of the die, the air pressure is admitted through the top. This type of pot is best suited for aluminum alloys.

To gain some idea of the production capacity of die casting machines, it may be stated that the frame shown in Fig. 4 equipped with a plunger cylinder for lead alloys, and a multiple impression die, was capable of producing 100,000 fuse holders for hand grenades in 24 hours during the war period. In other words, it was pumping nearly a ton of lead alloys each hour of operation.

The die casting process, the same as any other process, has its limitations. Failure of parts were suited to the process, is due in the majority of cases to incomplete information regarding conditions under which they are used, and consequent incorrect selection of the proper alloy. One is no more justified in merely ordering a die casting without proper consideration of the specific alloy best suited, than he would be in ordering a piece of steel without considering whether it is to be a low or high carbon or alloy steel. A progressive die casting concern has, or should have, the necessary data on the alloys.

The group of tin-base die castings finds their largest field of application in bearings for motors. They are suitable for small parts on galvanometers and player pianos. They are not effected by water, weak acid or alkaline solutions, and when free from lead are extensively used for parts of soda fountains, cream separators, etc.

The lead-base die castings are used for low pressure bearings, ornamental metalware, and parts that come in contact with corrosive chemicals, as in fire extinguishers. They should not be used for parts that come in contact with foods. Their main advantage lies in their comparatively low cost.

Zinc base die castings should not be used where they are subject to sudden shocks. They are corroded by alkaline or aqueous solutions of any salts. They tarnish when exposed to ordinary atmospheric conditions, but they may be protected with any kind of a plating, casting or enamel finish, preferably of the air dryed type. Great care must be exercised in alloying zinc base die castings because of the tendency toward deterioration, due to crystal growth. Zinc-base die castings are used extensively on automobile parts, also on calculating and vending machines, pencil-sharpening machines, etc.

Aluminum die castings do not deteriorate under atmospheric conditions. They are used on vacuum sweepers, and on automobiles in the form of steering wheel spiders, throttle control sets, break shoes, deck bars, and parts of a kindred nature.

Sand Is Not Suitable

Question: Under separate cover I am sending you two sample of molding sand from deposits in this vicinity and will appreciate your opinion on which is the more suitable for making medium weight castings.

Answer: The two samples of material which you recently sent to this office are not suitable for molding sand. The clay content is too high and the sand to too *close*. In other words and to employ the usual foundry phrase, the vent could not get through it. Metal poured into a mold made from this material would not lie quietly. You might try a simple test. Wet a small quantity, squeeze it into a ball in the hand and then set it some place to dry. In a few hours you will find that it has dried as hard as a brick. In fact the material submitted which we tried out by this primitive but practical foundry test exhibited strong resemblance to the adobe brick employed for building purposes in the south west.

E. W. Taylor has been appointed manager of the Pittsburgh office, Oliver Bldg. of the Brown Hoisting Machinery Co., Cleveland.

Special Planes Assist Patternmaker in Finishing Irregular Surfaces

By Walter C. Ewalt

WHILE the jack, smooth and fore planes described in a recent issue of the THE FOUNDRY, are used extensively by the patternmaker, other types also are useful. This article will deal with the rabbet, round sole and corebox planes. The block, jack, smoothing and fore planes are classed as bench planes and are used for planing flat surfaces. The rabbet, round sole and core box planes in a sense are special tools and are classed as grooving planes. In general with this type of tool, the sole of the plane is a match for the work which it produces. This feature is shown in Fig. 2. Several exceptions are noted, namely the corebox plane, draw knife, router, etc. While it is true that the curved surface on the work shown in Fig. 2 *A*, may be worked with a bench plane, it is far more convenient to have a plane shaped to fit the round. This is more noticeable in Fig. 2 *B*, where the hollow portion would be worked out with a gouge. While four bench planes may be sufficient for use on straight work, the number of so called special planes will be increased correspondingly if the work being done is greatly diversified.

A rabbet is a groove cut longitudinally in the edge of a board into which another board is allowed to fit. The joint made in this manner is called a lap joint and may be seen easily in Fig. 1. A rabbet plane is shown in Fig. 3. It is manufactured in sizes from ¼ to 2 inch and, as may be noted in the illustration, the sole is square with the side. The plane shown in Fig. 4 is called a cabinetmaker's plane and has some valuable features. The sole is square with both sides, so that the plane may lie on either and may be worked with either the right or left hand. It has an adjustable throat, a handy grip and the cutters are adjustable endwise. The blade extends out near the toe, giving greater working capacity, while the front may be removed making it an edge or chisel plane. This enables the operator to work close to the corners. The tool has a 1-inch blade and is 4-inches long.

Some rabbet planes have an adjust-

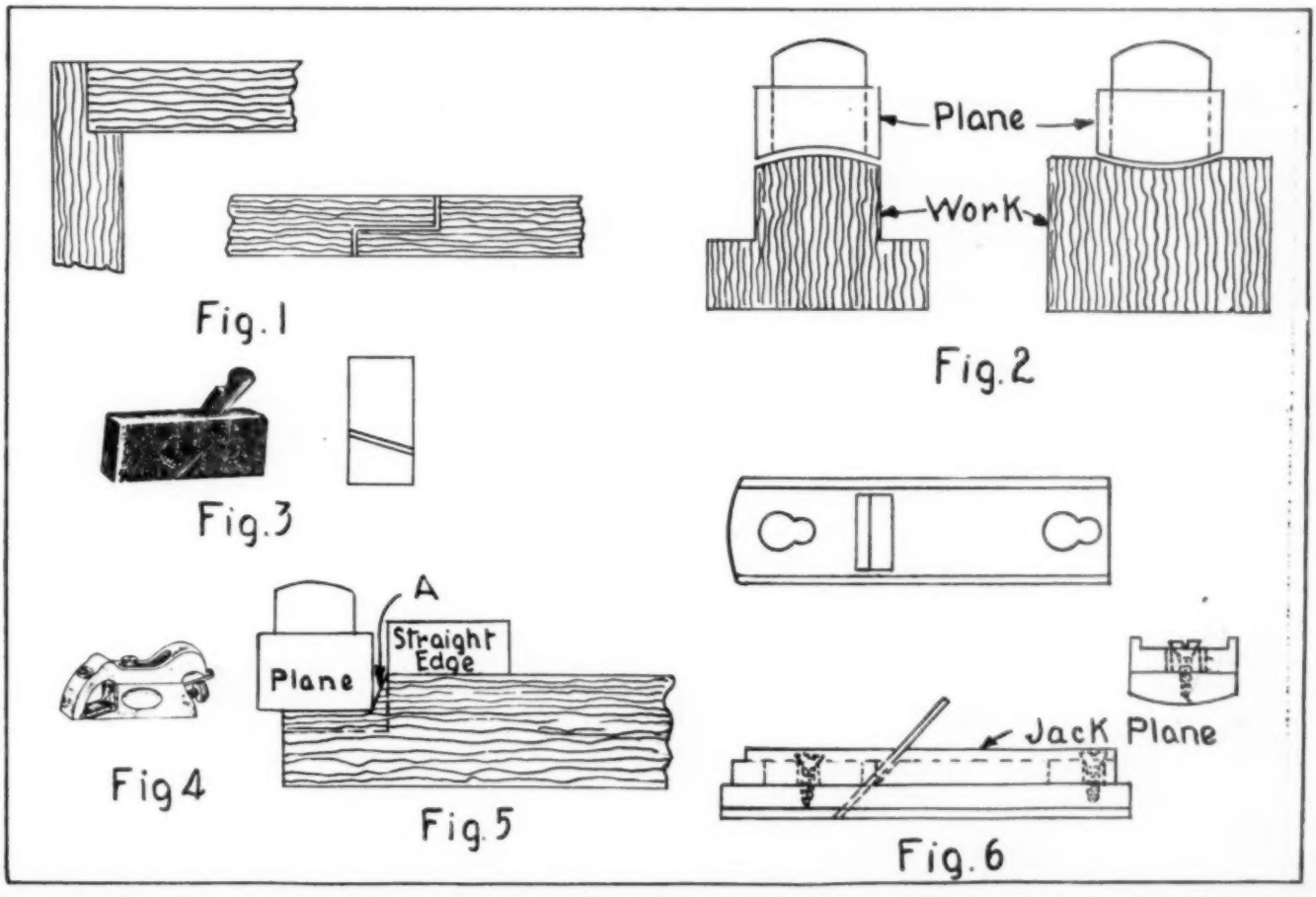


FIG. 1—MATERIAL CUT FOR LAP JOINT. FIG. 2—THE SOLE OF THE PLANE FITS THE WORK PRODUCED. FIG. 3—THE RABBET PLANE. FIG. 4—CABINETMAKER'S RABBET PLANE. FIG. 5—THE RESULT OF CARELESS PLANING. FIG. 6—JACK PLANE CONVERTED INTO A ROUND SOLE PLANE

able depth gage which is fastened on one side of the plane to regulate the depth desired. Some types also have a spur cutter which acts as a knife and makes a cut into the wood, the depth depending on the length of the blade below the sole. This leaves a smooth shoulder, especially on cross grain.

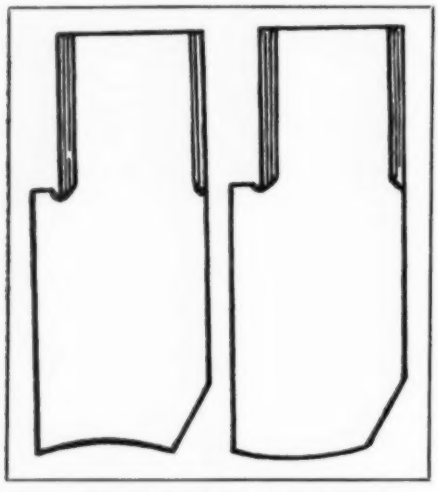


FIG. 7—TERMS HOLLOW AND ROUND REFER TO THE SHAPE OF THE CUTTING EDGE

Otherwise the wood may be rough, caused by the blade breaking the fibers rather than cutting them cleanly

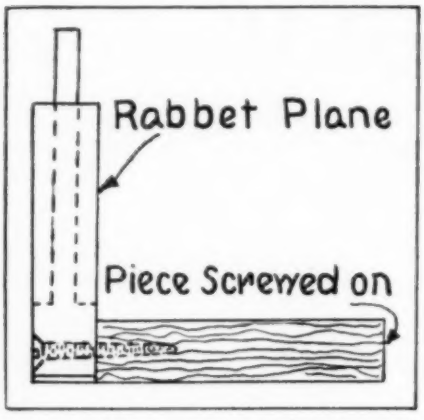


FIG. 8—RABBET PLANE USED TO CUT SEMICIRCLE

When the blade of a rabbet plane is set on a skew, that is at an angle to the edge of the plane as shown in Fig. 3, it cuts more easily and smoothly than if set square across. However, if set on a skew, right and left hand planes will be required, due to differences in the grain of the wood. As previously mentioned in connection with bench planes, a piece of wood often must be reversed because it will plane easier and smoother from one end than from the other. Cutting with the grain makes a smooth job as it presses down the fibers lying in a direction away from the plane. When planing against the grain the fibers are pointing up and toward the plane, which has a tendency to tear them up. When planing a flat surface it may be possible to turn the work end for end, but when making a rabbet this is not possible. For this reason it is

FIG. 9—A SPECIAL COREBOX PLANE

necessary to have a right and left hand plane if a skew plane is used.

If the blade is parallel to the grain, as at the end of a board, it is difficult to cut across the grain in soft wood,

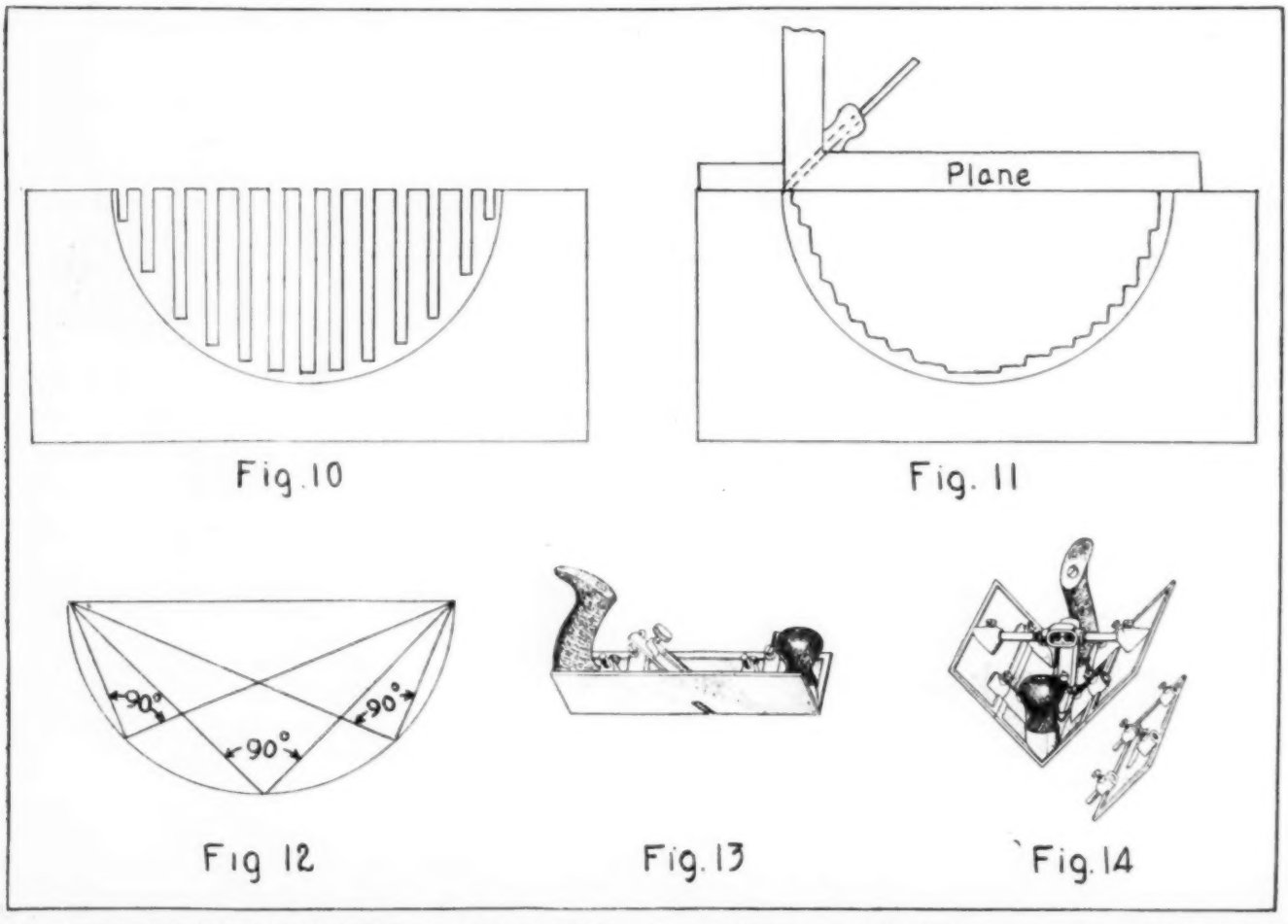


FIG. 10—THE SEMICIRCLE IS CUT WITH A SAW OR GOUGE. FIG 11—METHOD OF PLANING. FIG. 12—THE PRINCIPLE ON WHICH THE PLANE IS BUILT. FIG. 13-14—THE COREBOX PLANE

for example pine, where the fibers are open and not strong, although in hard woods it does not make much difference. For this reason, the skew bladed plane which gives a shearing cut, is best for rabbet planes. The rabbet planes are made so that the shaving is discharged or turned out on the opposite side from the shoulder, preventing any shavings from getting between the plane and the work. It will be noticed that the blade of a rabbet plane extends from side to side of the plane. The size of the plane is determined by the width of the face. Usually in making joints such as shown in Fig. 1, the joints are laid out and a back saw is used to cut down on the line to the depth desired. The wood then is chiseled out and finished smooth with a rabbet plane. Sometimes a straight edge is tacked along the side of the line as a guide for the rabbet plane and no chiseling is done. Care must be taken to keep the plane square with the surface and crowded to the straight edge, or the result will be a job similar to that shown in Fig. 5. In this case the plane is being worked out, making an angle at *A* instead of being square.

The round sole plane is an iron tool with interchangeable soles of aluminum having different radii, either convex or concave, and attached to the frame with screws. The planes are used for making hollows or rounds in patterns, such as fillets, curves and coreboxes. If necessary hard wood blocks may be planed and finished with still different radii and attached in the same manner as the aluminum soles. A jack plane may be equipped by drilling and slotting a couple of holes in the sole of the plane so that the soles readily may be taken off and put on. Fig. 6 shows the slotted hole. The larger part of the hole allows the head of the screw to clear. The sole then is driven forward and the bevel underneath the head of the screw wedges the hard wood blocks up to the sole of the plane.

A special blade is required for each different radius sole. The terms *hollows* and *rounds*, which are concave and convex, alludes to the shape of the cutting edge of the blade, as shown in Fig 7. The sizes, widths and diameters of wood planes also are shown.

In hollow and round blades, most of the cutting is done at the center of the arc, while near the ends a scraping action is encountered. This occurs chiefly when the arc approaches a semicircle. To secure the best cutting action, the plane should be sufficiently narrow to allow three or more positions to be used to hollow the work. In other words, if the diameter of the circle is 3 inches, the width of the plane should be from 1 to 1½ inches.

It is rather difficult to get a perfect arc with a round plane so a corebox plane was designed for the purpose. Several types may be obtained, The one shown in Fig. 13 is based on the principle that if from any point on the arc of a semicircle lines are drawn to the ends of the diameter, the included angle will be a right angle. This may be seen in Fig. 12. The sides of the plane are at right angles and the point of the blade is at the apex of that angle. This feature must be watched carefully when setting the blade in the plane, or the work will not be a true semicircle. The semicircle first is laid out by straight lines on the face of the block of wood and semicircluar lines on the ends. The semicircle is cut out with a circle saw or gouge to within ⅛-inch of the line, as shown in Fig. 10.

A thin straight edge then is tacked on the line on the face, and on one side the block is cut down about ⅛-inch with a corebox plane. This defines the line on one side, the other side being determined in the same manner. The straight edge then is removed and the plane should rest on both edges. The cuts are continued half way around and the process repeated on the other side. An accurate half circle will be planed out if care is exercised in working this plane, as shown in Fig. 11. Care must be taken to prevent the edges from being destroyed, otherwise, a perfect circle cannot be made. A plan with the additional sides which may be attached is shown in Fig. 14, the size ranging from 1 to 10 inches. A suitable plane of this style may be made by using a rabbet plane and screwing a piece of wood at a right angle to its side. The piece is fastened about 1/16-inch, or the thickness of a shaving, below the sole of the rabbet plane, as shown in Fig. 8. A corebox plane working on another principle is shown in Fig. 9. The cutting tool is attached to the center head and the plane is moved back and forth. The feed is regulated with suitable mechanism. This plane may be used in making a corebox from ¾ to 6-inch diameter. The wood is prepared as for the other plane, except it is necessary to have one side straight and parallel with the line on the face of the wood which connects the two ends of the semicircle.

Faked Foundry Facts

Too Much Sand

Offer Graduate Course

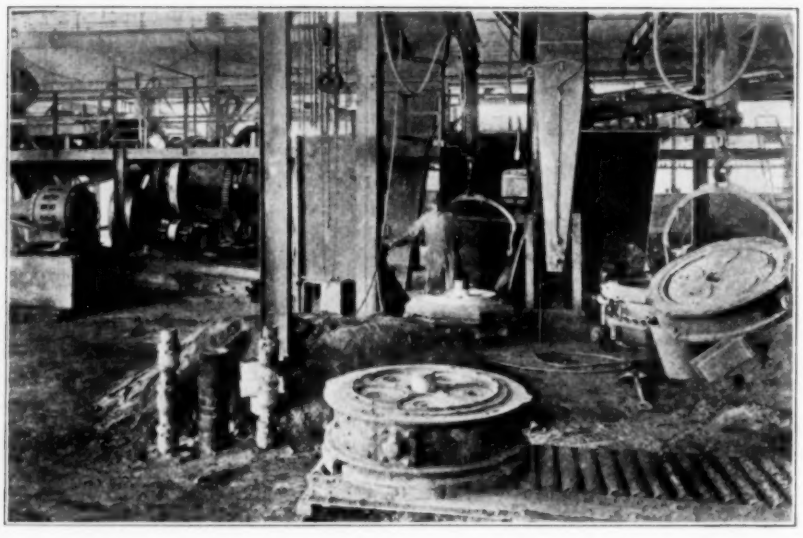
The University of Michigan, Ann Arbor, Mich. describes its course in chemical engineering, and of graduate courses in general chemical engineering, metallurgical engineering, gas engineering, and organic chemical industries in a recent bulletin.

The publication gives general information of the governing body of the institution, the number of students enrolled, admission requirements, and facilities for instruction and research.

Steel Institute Meets

The annual meeting of the Iron and Steel Institute of Great Britain, was held at the Institution of Civil Engineers, Westminster, London, on May 7 and 8. The newly-elected president, Sir Frederick Mills, presided. The bessemer medal was presented to Prof. Thomas Turner, president of the Institute of Metals. The autumn meeting of the Society will be held in Birmingham on September 9, 10 and 11.

C. H. Martin, Chicago, has been made district representative in Wisconsin and Illinois for Holcroft & Co., Detroit. Mr. Martin formerly was connected with the Peoples Gas, Light & Coke Co. on special heat treating development work.



Handling Sand

Mechanical Preparation and in Continuous System for

Drag and Cope Are Molded on Separate Machines and Are Swung to a Roller Conveyor, Cored and Closed

QUANTITY production methods and application of mechanical equipment in the foundry are prominently in evidence in one section of the steel foundry operated by the Dayton Steel Foundry Co., Dayton, O. The company handles a miscellaneous line of castings, but specializes on steel wheels for auto trucks and it is in that part of the foundry devoted to the production of wheels that the molding, pouring and shake out methods have been standardized to facilitate continuous operation. The present installation, like many innovations in other foundries was not developed in its entirety at one time. Rather, it was the result of several contributory conditions and to a certain extent was regarded as experimental. Successful operation over a period of more than a year has demonstrated its practicability and economy and also has justified the faith and judgment of both the management who placed the order for the equipment and the engineers who worked out the details.

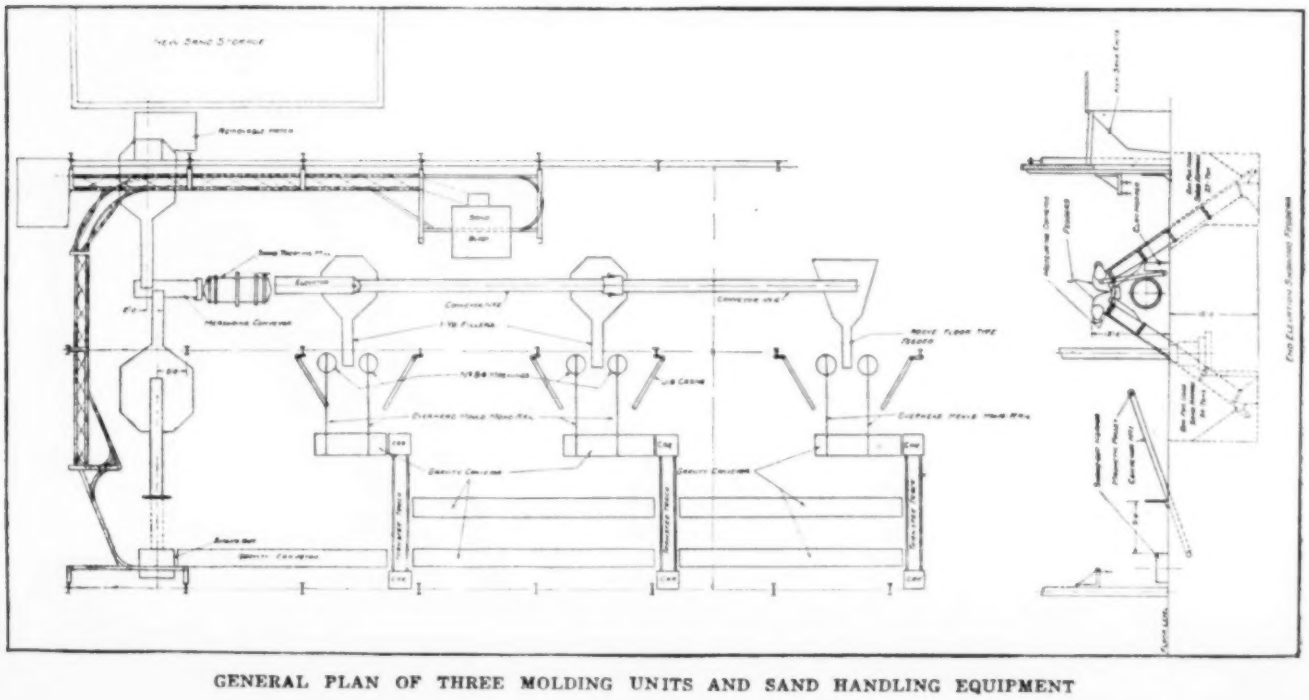
History of the method now in use dates back to the installation of two molding machines by the Osborn Mfg. Co., Cleveland. These machines are of the jolt stripping plate type, one for the drag and one for the cope. Sand was shoveled by hand and the flasks were lifted from the machines, assembled on the floor, poured and shaken out by one of the electric traveling cranes. With the advent of a second pair of machines it was discovered that the supplementary service was inadequate and as a result the molding machines were handicapped, they could not be operated to capacity.

Two courses of action confronted the management. In one they could sit back with folded hands and content themselves with the reflection that they were doing as well as they could under existing conditions. In the second they could have reproached the molding machine maker bitterly on the ground that the machines were idle a considerable part of the time and therefore they were not reaping the benefits they anticipated when they secured them and placed them in operation.

Solved the Problem

Singular as it may seem they did not adopt either course. They surveyed the problem calmly and applied another solution based on what usually is known as ordinary or common sense.

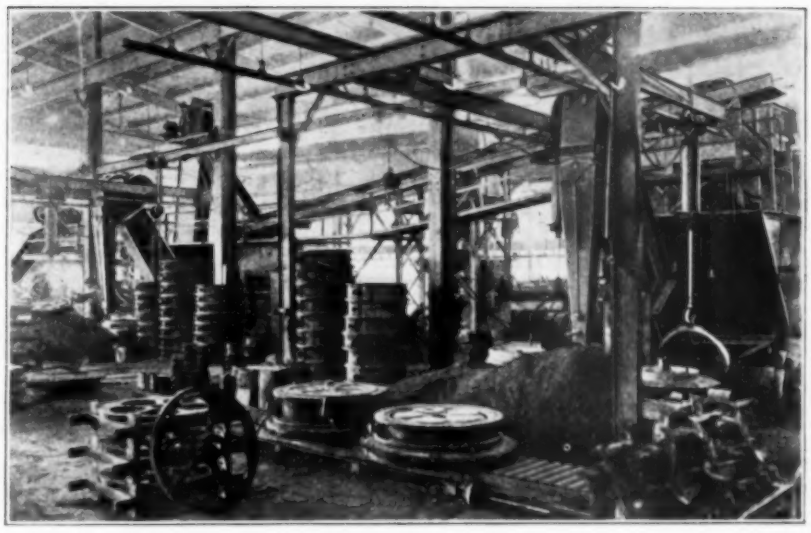
Two young brothers Jacob and George Walther came from Germany and after a few years located in Dayton several years ago. They learned the molding trade and the measure



GENERAL PLAN OF THREE MOLDING UNITS AND SAND HANDLING EQUIPMENT

to Speed Output

Distribution of Sand Used Making Steel Truck Wheels



When Closed and Clamped, the Completed Molds Are Moved on a Transfer Car to The Pouring Conveyor

of their success is indicated by the fact that they now control and manage the plant of the Dayton Steel Foundry Co. Exercise of common sense and intense application to their own business has characterized their progress and therefore in the present instance it is only natural to find that they adopted the obvious method in solving their latest problem. They consulted the makers of the molding machines to devise a method of utilizing the full productive capacity of the machines. The result is partly shown in the accompanying illustrations, but will be appreciated more readily from the statement that four machine operators two core setters and one closing man now make an average of 140 truck wheel molds on each of the three molding units in the system.

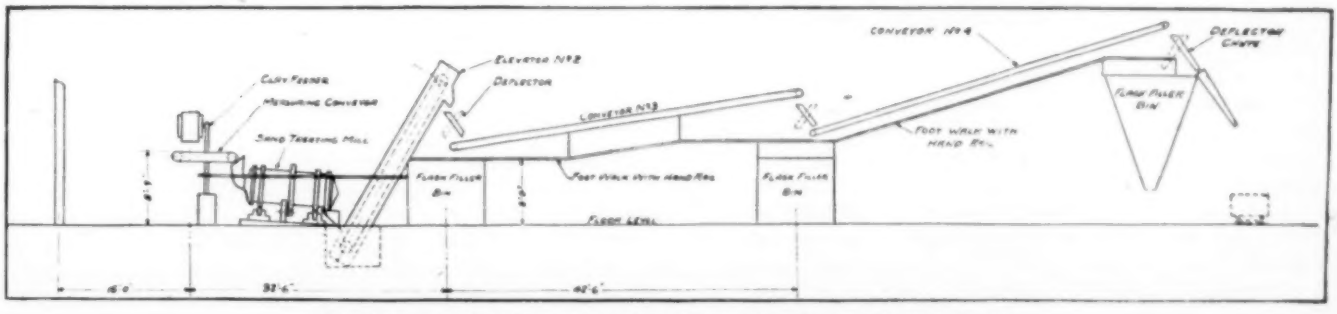
The general features of the plan worked out by the engineering staff of the Osborn Mfg. Co., Cleveland, may be noted in the plan on page 412. The equipment occupies a rectangular floor space approximately 50 x 150 feet. The shakeout and sand supply which forms the beginning of the cycle are located across one end. The sand reconditioning and distributing apparatus extends all along one side. The molding machine units occupy a space in the main bay close to the steel columns which support the roof of the building and the crane runway. The sand supply bins and the conveying mechanism which discharge sand into the hoppers serving the machines are located in the side bay adjoining and close to the same columns. The molds are closed and cored on a conveyor in front of the machines and then transferred on a movable section of the conveyor to a second roller conveyor forming the fourth side of the rectangle where the molds are poured. The latter extends to the shakeout where the castings are removed, the flasks are returned to the molding stations and where the sand starts on its return journey.

Preliminary Mixing

Probably the most statisfactory method of presenting a description is to commence at the shakeout station and follow the sand on its journey through the various bins, elevators, mixers, belts, hoppers, into the flasks and out again at the point where the cycle may be said to begin and end.

The sand falls through a floor grating into a large hopper from which it is delivered to a bucket elevator and discharged upon a large inclined screen mounted over a steel bin located partly below and partly above the floor level. The screen catches nearly all the miscellaneous scrap lifting plates and gaggers not previously removed by the magnetic separator and slides them off to a point outside the bin while the sand falls through the bars. A water spray strikes the falling sand and prevents a cloud of dust from arising in addition to cooling the sand and giving it a preliminary wetting down. The castings are poured in green sand molds and although they are comparatively bulky the metal section is thin, averaging only ¼ inch and therefore the sand is not burned. The greater part of the sand in the flask is not even dried from the heat of the casting. The molds are dumped almost immediately after they are poured and before the heat has time to penetrate the body of sand.

A heavy steel bucket sand feeder driven by a 20-horsepower variable speed motor lifts the sand from the bin to an elevated measuring conveyor belt which discharges into a revolving mixing drum. A second sand feeder driven by a variable speed motor located opposite the first, lifts new sand from a hopper in the floor of the side bay and feeds it on to the measuring conveyor belt simultaneously with the old sand. The hopper in the floor is located at a point in front of the sand storage shed which adjoins the foundry building and is kept filled by a grab bucket suspended from a crane. This crane operates on a track extending the full length of the build-



ELEVATION OF SAND HANDLING AND CONDITIONING EQUIPMENT

ing and unloads all incoming materials through suitable openings in the roof over the various storage spaces.

Clay for restoring the bond in the sand first is dried and then pulverized in a pan mill made by the National Engineering Co., Chicago. It is shoveled into a small hopper and fed by a bucket elevator to the measuring conveyor belt at the same point where the old and new sand meet. Thus the three ingredients of the sand mixture start together and enter the revolving drum uniformly and in definitely predetermined proportion. Water is added to the stream of sand at the point where it enters the drum. A man stationed on the bridge regulates the amount of water and this is the only point where the variable human element enters into the sequence of sand preparation. However, the man is experienced, the condition of the sand is fairly uniform as it enters the mill, the watcher constantly is on the alert as it leaves the mill, he squeezes a handful at frequent intervals and therefore the danger of unsuitable sand passing to the molding machine hoppers practically is negligible.

It is claimed the mixing drum operates on a principle never before applied to mixing sand for foundry use. It is mounted on a slight incline and is equipped with a number of lengths of steel shafting which revolve independently of each other while submerged loosely in the mass of sand. In effect it amounts practically to a tumbling barrel into which the sand is fed in a continuous stream at one end. By the time the sand has worked to the opposite end of the mill the various ingredients are incorporated thoroughly in the mixture, the sand is cool and properly dampened, it is loose and open and in proper condition to enter the flasks.

Prepared sand falls from the lower open end of the drum into the boot of a bucket elevator. The elevator discharges the sand either directly into an octagonal steel storage bin or onto an inclined belt conveyor extending to a point immediately above a second storage bin. A deflecting chute mounted on a pivot below this end of the belt may be swung to direct the sand into the bin or to the floor for wheeling in barrows to the third molding station. Each of these bins is directly in line with one of the molding units. The third unit will be served in a similar manner, but the equipment is not yet completed.

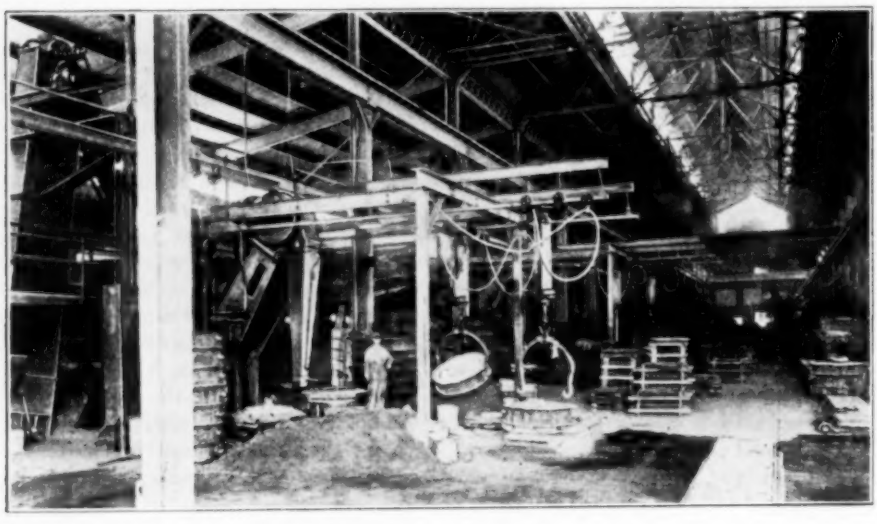
At periodical intervals the feeder for old sand at the end of the system is stopped for the preparation of core sand. New sand exclusively with a small addition of oil, sawdust and a dry core binder is passed through the mixing drum and discharged over the end of the belt conveyor into trucks which carry it to the core making department, located in the opposite side bay of the building. The storage bins have sufficient capacity to offset any danger of a holdup at the molding stations while the core sand is going through the system, or while the system may be temporarily out of commission through any other cause.

The entire system is controlled electrically from a switch board erected on the floor behind the mixing drum. An emergency control panel attached to the rail of the bridge where the man in charge of operation is stationed, furnishes a ready means of stopping any of the various pieces of equipment should occasion arise.

Sand for Machine

A flask filler working from each storage bin discharges sand into a swinging spout suspended midway above each pair of molding machines. The operator swings the mouth of the spout over his flask and by pressing a button on the spout, starts the elevator which in turn discharges a stream of sand into the flask. When the flask is filled the operator releases the spout and the button. The elevator stops and the spout automatically swings to a vertical position out of the way midway between the cope and drag machines.

The flasks are circular and close fitting, either 36 or 40 inches diameter with 9 or 10 inch cope and 10 or 12-inch drag. The bars are comparatively shallow and do not extend down inside the pattern. The body of sand above the arms and between the rim and the hub is supported in an ingenious manner by a set of lifting plates that resemble exaggerated stem chaplets. In the drag the head of the chaplets rest on the pattern plate and the stem extends a short distance above the upper surface of the flask. In the cope these chaplets rest on a thin layer of sand.



The Three Molding Stations Deliver the Completed Molds to a Common Pouring Conveyor and Thence to the Shakeout and the Sand Is Returned into the Conditioning System

One of these lifting plates is placed in each of four spaces between the arms of the wheel. The horn gate core rammed in the fifth space serves for a lifter at that point.

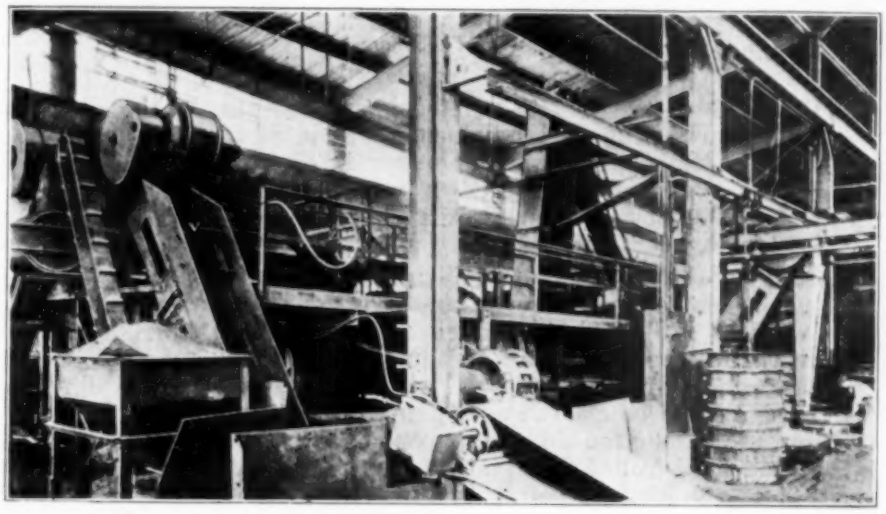
After the mold is jolted, the top is butted with a pneumatic rammer and then scraped off flush with the top of the flask. A thin strip of wood corresponding in a general manner to an old fashioned bootjack is attached to the projecting stem of each lifting plate. The wood strip rests on the bars of the flask. A lifting plate on the molding machine strips the mold from the pattern. An air hoist suspended from a beam attached to the building columns serves to remove the half mold from the machine, roll it over and place it either on the conveyor or on the drag. Before the drag is placed on the conveyor the lifting plates between the arms are removed and are reset in the following drag on the molding machine. In this manner one set of plates serves for all the drags. On account of the fact that the cope must be rolled back to its original position before it is closed down on the drag, the plates are not removed. They remain in position until after the casting has been poured and are recovered at the shakeout station.

Molds are cored and closed on a

short roller conveyor in front of each pair of molding machines from which they are transferred to the parallel pouring conveyor. They are allowed to accumulate on the latter conveyor until a heat of steel is ready. Then they are poured and pushed toward the shakeout to make room for others. The movement is continuous all day.

After the molds are shaken out, the castings are picked up by suitable tongs suspended from a monorail and taken to the cleaning room. The empty flasks are returned to the molding stations on a second roller conveyor which parallels the pouring conveyor. In an emergency a pile of empty flasks is picked up by the crane and returned to the molding stations.

The following figures based on an approximate output of 500 wheels per day illustrate some of the advantages of the system, the amount of sand required and the number of men employed.



New Sand and Ground Clay Are Delivered to a Mixing Belt and With the Old Sand Pass Through a Continuous Mill Before Delivery to the Molding Machine Hoppers

Three times a week two men mix 10 tons of core sand in 1½ hours. Under former conditions three men worked three 9-hour days in preparing a like quantity. Three men attend the molding sand equipment which delivers 18 cubic yards of sand per hour. Each molding unit employs seven men, four men ramming, two men coring and closing the molds and one man building runners and clamping the molds. Under the new dispensation satisfactory molding sand is made up of 10 per cent new sand, 90 per cent old sand and less than 1 per cent clay.

Shows Personal Interest

In a bulletin issued by the department of commerce and labor of the state of Pennsylvania, W. H. Steel, shop engineer, Locomotive Stoker Co., Pittsburgh, submits information on how his company induced the employes to wear goggles.

This company always has been interested in safety. It carries its own compensation insurance, and in case of an accident pays $15 a week to an injured employe from the date of the accident, together with unlimited medical or surgical service when needed. It also has inaugurated an old age service pension, a dependency pension plan, group insurance, and a sickness relief plan.

The company considers all of these institutions good safety measures, and the record for the past nine years, during which time some twelve million man hours were worked, shows no fatalities, and partial permanent disabilities of only one eye loss, and a total loss of five fingers.

Mr. Steel states that in the early days they had trouble in the chipping room of their iron foundry in trying to get the men to wear goggles. Their hospital reported a large number of *foreign particle* cases, and the men absolutely refused to wear goggles. The company posted literature, extracts of the law; and threatened dismissals. Even the periodical visits of the state factory inspector did not help matters.

However, this problem like all safety problems, is easy of solution when properly understood in all its ramifications. Mr. Steel explains how the company overcame the men's prejudice as follows:

We finally decided to try a little psychology. Instead of threatening these men, we merely filled our pockets with as many different designs of safety goggles as we could find, went to those men, talked to them, showed them all the different varieties of goggles, and let each man make his own selection. We then fitted the goggles to each man's face carefully so that he was comfortable while wearing them.

This procedure made each one of those men feel that the safety man had a real personal interest in his welfare; and believe me it worked as evidenced by the fact that during the year, 1924 we have not had a single lost time accident of any kind from that department.

Advise Annual Lecture

The executive committee of the American Society for Testing Materials intends to recommend to the society at its annual meeting to be held at Atlantic City in June the establishment of an annual lecture to be given to commemorate the name of the society's first secretary, Edgar Marburg, 1864-1918. Serving as secretary from 1902 until his death in 1918, Mr. Marburg put the work of the society on a firm foundation and, through his development of the technical programs year by year, brought wide recognition to the society as a forum for the discussion of properties and tests of engineering materials.

It is recommended that this lecture shall afford an opportunity for the society to be addressed by leaders in the field of engineering materials who will present outstanding developments in the promotion of knowledge of engineering materials, and shall carry with it an honorarium of $200 and a suitably engraved certificate.

To Manufacture and Sell Oil Engines

A connection has been arranged between Carels Brothers, Ghent, Belgium, and the Ingersoll-Rand Company, New York, by which the Belgian concern will have the right to manufacture the solid-injection type oil engine, designed by the American manufacturer.

Carels Brothers, organized in 1875, are officially known as the. Societe d'Electricite et de Mecanique.

Earl E. Miller has been made manager El Paso, Tex. for the Sullivan Machinery Co., Chicago, succeeding R. S. Weiner, who is transferred to the general office in Chicago. Mr. Miller has been with the company over 13 years at the offices in Denver, Lima, Peru, and Paris, France.

The Shakeout

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PAT DWYER, Engineering Editor
CHARLES VICKERS, Nonferrous Editor
GEORGE A. DRYSDALE, Metallurgical Editor
FRANK G. STEINEBACH, Associate Editor

¶ Welding Becomes Ambitious

RECENTLY published reports of a paper presented before a divisional section of the American Welding society indicates the extent to which men engaged in the welding industry are extending their activities into fields formerly dominated by the foundry.

Formerly welding was considered a kind of an adjunct, a timid hanger-on to other fabricating processes. It was considered a necessary evil, a measure employed to prevent a defective piece of work from going to the scrap pile.

It is still employed extensively in that capacity, but with commendable energy and aggressiveness the welders are reaching out in an endeavor to prove that welding, instead of being a secondary operation, is competent and has all the necessary qualifications to be classed as a primary industry. Examples were cited in the paper of many instances where rolled steel shapes were electric welded at the contact points to take the place of more cumbersome iron castings.

THE report, in common with all reports designed to magnify one side of a question at the expense of minimizing the other side, was biased to a certain extent, particularly in a comparison of the relative cost of welding and of a suitable casting for the same service. Even so, this report and others of a similar character are bound to have an effect. If any moral is to be drawn it is that foundrymen will have to stir themselves out of their lethargy, if they are to retain their legitimate share of available business in the metal industrial field.

¶ New Flasks for Old

TANGIBLE evidence in favor of the recommendations of the pattern and flask standardization committee of the American Foundrymens association is presented in a report recently submitted by a prominent foundry in southern Ohio. For a period of many years this foundry company had built flasks in a haphazard manner to meet current requirements and the result was a miscellaneous collection without order, sequence or uniformity in size, shape, or method of attaching ing handles or guides.

A new policy was adopted in accordance with the proposals of the committee. A survey of the flask requirements was made and the company, to its astonishment, found that five standard size flasks were ample to take care of its many patterns. The sizes only apply to the width and the length. Any required depth over a definite unit measurement which varies with the overall size of the flask, is attained by attaching two or more sections to each other.

ONE of the most gratifying features in connection with making the change, was the discovery that it cost nothing. All the old flasks were scrapped and melted and yielded more than sufficient iron to pour a set of new flasks. The claim might be advanced that the yardfull of old flasks had a certain inventory value. Theoretically and perhaps in accordance with a certain style of bookkeeping, that may be true, but from a practical viewpoint they actually only represented their value in scrap metal.

¶ Where Civic Pride Falls Short

CIVIC pride is worthy and no one cares much for an individual who will not stand up for his own home town. Local patriotism often reaches the heights of zeal in the person of the secretary of the chamber of commerce. Every time he considers the delights of Smithville or whatever his town may be called in the postal guide, he admires the exceptional opportunities it offers to new industries and new commercial enterprises. His ambition soars and his heart begins to skip beats while he scans the far horizon for new manufacturing interests which he may be able to induce to start a plant in his old home town. A new foundry often proves an attractive thought and someone is induced to accept a tract of land along the X-Y-Z railway, build a shop and start operations. Unfortunately that admirable quality of civic pride feels that its duty is accomplished at this point and too often it fails to bring along sufficient local business to keep the new shop in operation. After all, the attraction of a half cent a pound from another city often outweighs local pride in the mind of the castings user.

Why this differential of half a cent a pound should exist might be a subject worthy of investigation on the part of the secretary of the local chamber of commerce, or by other members of that august body. The fault may be found in the manner in which the foundry is conducted. In that case, the remedy is obvious. Under any other set of conditions a little timely help from near home may be of reciprocal benefit.

Trade Outlook in the Foundry Industry

GENERAL business has slowed down during the past few weeks until in many lines production is on a level or below the current consumption. This fact is taken to indicate in a positive manner that the trend in the near future will be upward both in demand and in manufacturing activity. The foundry industry, aside from a few individual classes of castings production, follows this same general movement. Jobbing foundry operations are spotted, but in general they range from 60 to 75 per cent of capacity. Railway demand is increasing. Automobile foundries are experiencing varied fortunes, governed by the demand for the cars in which their products are used.

Autos Gain Headway

A hopeful feeling prevails in automotive manufacturing lines. This outlook characterizes the industry from season to season, despite the croaking of those who predict the early approach of the saturation point in passenger car sales. The production as officially announced for March was 377,000 automobiles and trucks including those manufactured in Canada. This is 4 per cent below the maximum production last year which was reached in March. However, March this year was 31 per cent ahead of February with its total of 287,119, and was the largest production since April last year. Dealers report increased sales with probably 85 per cent of the demand for closed cars. A number of manufacturers who operate their own foundries have increased their castings production. One such foundry poured a record heat of 307 tons of gray iron castings on May 1 and reported its output of castings as below the current demand from its machining and assembly divisions. The exports of automobiles of all classes is increasing, according to the department of commerce.

Prices for Raw Materials for Foundry Use

CORRECTED TO MAY 7

Iron		Scrap	
No. 2 foundry, Valley	$19.50 to 20.00	Heavy melting steel, Valley	$17.25 to 17.50
No. 2 southern, Birmingham	18.50 to 21.00	Heavy melting steel, Pitts.	16.50
No. 2 foundry, Chicago	22.00	Heavy melting steel, Chicago	14.75 to 15.25
No. 2 foundry, Philadelphia	21.76 to 22.26	Stove plate, Chicago	14.50 to 15.00
No. 2 foundry, Buffalo	19.50 to 20.00	No. 1 cast, Chicago	18.75 to 19.25
Basic, Valley	19.50	No. 1 cast, Philadelphia	17.50 to 18.00
Basic, Buffalo	19.00 to 20.00	No. 1 cast, Birmingham	16.50 to 17.00
Malleable, Chicago	22.00	No. 1 cast, Buffalo	15.50 to 16.00
Malleable, Buffalo	19.50 to 20.00	Car wheels, iron, Pittsburgh	16.00 to 16.50
		Car wheels, iron, Chicago	15.50 to 16.00
Coke		Railroad malleable, Chicago	17.25 to 17.75
Connellsville foundry, coke	$3.75 to 4.50	Agricultural, mal., Chicago	16.50 to 17.00
Wise County foundry, coke	4.50 to 5.25	Malleable, Buffalo	17.00 to 17.50

Pig Iron Declines

April showed a drop in pig iron production, according to statistics compiled by the *Iron Trade Review*. The total output of all classes of pig iron in April amounted to 3,211,235 tons, compared with 3,571,422 tons for March. On a daily average basis, the April output was at the rate of 107,041 tons per day, compared with 115,207 tons for the previous month. This was a decrease of 8166 tons per day or 7.1 per cent. Merchant grades also showed a decline during the past month. The total output of this class of pig iron was 689,162 tons, a loss of 47,122 tons when compared with the March total of 736,284 tons. On a daily average basis, April registered 22,972 tons per day as compared with 23,751 tons for the preceding month. The total number of furnaces active on the last day of April was 25 less than on March 31. During the month 2 merchant stacks were blown in and 5 shut down.

Rail Outlook Promising

Railroads again are buying cars in slightly increased numbers. The western roads are in the lead, some 25,000 cars being reported on inquiry in the Chicago district. Both southwestern and northwestern lines are in the market, but in the east the inquiry is depressed. Railway foundries continue active on existing contracts. Demand for steel castings has increased as a result of the adoption of a type of truck which uses a decreased amount of malleables in favor of steel castings. Despite the heavy movements of freight, the increase of idle cars is noted as a result of increased operating efficiency. Railway purchases of machine tools are in prospect, and the sale of heavy presses, due to automobile shop demand, is stronger. Steel mill operations continue at a high rate, although slightly below the pace set during the first few months of the year. Production in many steel lines is only slightly ahead of demand and increased requirements are expected by the end of June. A number of plants are installing steel mill machinery and roll foundries are busy. Foundries making castings for small compressors for garage and filling station service and compressors which are adapted to use in paint spraying equipment, are busy. March operations among Ohio foundries stood at 74.9 per cent of normal, compared with 74.1 per cent for February, according to A. J. Tuscany, secretary of the Ohio State Foundrymen's association.

Nonferrous Operations

Brass shops are fairly busy. The demand for railway and automotive bushings have been satisfactory for the past month. New York prices for nonferrous metals according to the *Daily Metal Trade* of May 7, follow: Casting copper, 13.12½c to 13.25c; electrolytic copper, 13.62½c; lead, 7.80c; Straits tin, 54.87½c; antimony, 15.50c; nickel, 38.00c; No. 12 remelt aluminum, 22.50c. Zinc is 6.92½c to 6.95c, E. St. Louis, Ill. Average monthly prices for April follow:

New York Prices

Castings Copper	Electrolytic Copper	Lead	Tin Straits	Antimony	Aluminum 98-99	Zinc St. Louis
13.196	13.533	7.986	52.201	12.481	27.00	7.001

Comings and Goings of Foundrymen

EUGENE W. SMITH, who has been superintendent of the No. 2 foundry of Crane Co., in Chicago, on April 25 was appointed general superintendent of all the foundries of Crane Co. Mr. Smith has been an employ of the Crane Co. for 53 years. His new post will necessitate frequent visits to the company's foundries at Bridgeport, Conn., Birmingham, Ala., Chattanooga, Tenn., and Montreal, Que.

James Linklater, for 12 years general superintendent of the Michigan Malleable Iron Co., Detroit, has resigned to go on an extended vacation.

J. W. Hargate, for many years connected with the Scullin Steel Co., St. Louis, has been appointed general purchasing agent of the National Enameling & Stamping Co., Granite City Ill.

Frederick A. Noble has been appointed general manager of the McShane Bell Foundry Co., Baltimore. Mr. Noble entered upon his new duties March 1.

Alfred L. Humphrey, president of the Westinghouse Air Brake Co., has been elected a director of the American Brake Shoe & Foundry Co., filling a vacancy on the board.

Benjamin Nields, Jr., sales agent for the National Malleable & Steel Castings Co., Cleveland, railway sales department, in New York, has moved his offices from 30 Church street to 17 East Forty-second street, in the latter city.

Marc Stern has resigned from the Doehler Die-Casting Co., Brooklyn, N. Y., after 13 years service as chief engineer. During the past year Mr. Stern also held the position of technical representative with the sales department.

R. G. Clapp, purchasing agent of the Brown Hoisting Machinery Co., Cleveland, has resigned to become general manager of the Elyria Foundry Co., Elyria, O., subsidiary of the Brown company.

A. P. Cobb, vice president of the New Jersey Zinc Co., New York, was elected president of the American Zinc institute at the annual meeting in St. Louis the last week in April. Mr. Cobb has been prominent in the affairs of the zinc institute since its formation, having filled until the recent election the position of vice president and chairman of the executive committee.

Pat Dwyer, engineering editor, THE FOUNDRY was the principal speaker at the meeting of the Buffalo Foundrymens association held on the evening of April 30. This association recently has been reorganized with the following officers in charge: President, John McArthur, Washington Iron Works; vice president, Charles Hessler, American Radiator Co.; treasurer, James W. Gibney, Bingham & Taylor Co. and secretary W. J. Wark, E. J. Woodison Co.

Frank A. Anderson, National Malleable & Steel Castings Co., Cleveland, has been elected president of the Cleveland Purchasing Agents' association. Other officers are: vice president, J. E. O'Brien of the Fanner Mfg. Co.; and secretary-treasurer, D. N. Snetsinger of the Pittsburgh & Ohio Mining Co. New directors of the association are A. M. Boyer, Elyria, O.; W. L. Bosley, Bert Graves, C. W. Head, T. W. Johnson and S. H. Mansfield, all of Cleveland. C. D. Rawson of Elyria was elected director for two years in the national association.

Dr. Siegfried G. Werner, president of the German Foundry Owners' association, and one of the leading foundrymen in Germany is visiting in the United States where he will remain about a month. Dr. Werner came to the United States many years ago to study American methods and to finish his education. He spent several years at the Newburgh plant of the American Steel & Wire Co., Cleveland. At present Dr. Werner controls several steel foundries in the vicinity of Dusseldorf, Germany, where he resides. He is prominent in the interchange of new foundry processes and appliances between England, Germany and the United States. His headquarters while in America will be in care of F. K. Vial, vice president of the Griffin Wheel Co., Chicago.

F. E. Mesta, formerly vice president and general superintendent in charge of operations of the Mesta Machine Co., West Homestead, Pa., has been elected by the board of directors as president and general manager, to succeed the late George Mesta. H. F. Wahr, formerly secretary, was elected vice president; J. O. Horning, treasurer since its inception, will continue in that office; G. E. Townsend, formerly assistant secretary, was elected secretary; and the directors are as follows: F. E. Mesta, J. O. Horning, H. F. Wahr, W. J. Hirth and G. E. Townsend. Mr. Mesta received his early education in the public schools of Bethel township, Allegheny county, Pa., and was graduated from the high school at Leechburg, Pa. His practical experience in the iron and steel business was obtained at the plant of the Leechburg Foundry & Machine Co., Leechburg, Pa. Later he took up engineering and went into the engineering department of the Leechburg Foundry & Machine Co.; afterward, going on the road as selling representative of this company, as well as having charge of its outside erecting work. In 1898, Mr. Mesta took charge of the construction of the present foundry and machine plant of the Mesta Machine Co. at West Homestead, Pa., and was made general superintendent when the plant was put into operation. In April 1912 he was elected director and vice president of the Mesta company, in charge of operations, which position he held until his recent election as president and general manager after the death of his brother, George Mesta.

Elects New Officers

The Mt. Vernon Car Mfg. Co., Mt. Vernon, Ill., has elected officers and directors for the coming year. Neil K. Bond was elected a director in the place left vacant by the death of his father. The other officers are W. C. Arthurs, president; R. K. Weber, vice president; D. P. Settlemire, secretary-treasurer and G. Gale Gilbert attorney. G. L. Settlemire, A. C. Johnson, Iola E. Arthurs, G. B. Hawkins and Neil K. Bond are directors.

Move Headquarters

James E. Shearer, assistant sales manager of the Industrial Works, Bay City, Mich., has moved his headquarters from the home office to the New York office, 50 Church St. George T. Sinks, in charge of the New York district, will remain in that position.

The Falcon Bronze Co., Youngstown, O., has purchased the plant of the Lumen Bearing Co. of that city.

Will Feature Round Table on Brass Practice

A new departure in American Foundryman's association convention features, for the meeting in Syracuse, Oct. 5 to 9, will be a round table discussion on brass foundry problems. All the brass foundry foremen and superintendents are invited to attend the luncheon gathering to be held Tuesday noon, Oct. 6.

After the luncheon an informal discussion of shop problems will be in order. No prepared papers will be read, but short discussions will be called for by the chairman.

The program committee realizes that some of the past meetings on brass foundry topics have been of little interest to practical brass foundrymen, because the subjects discussed were devoted principally to the metallurgical phase of the industry. As the meeting is planned, the practical brass foundryman will have a chance to air his views on topics close to the shopman's interest.

Award Plant Contract

The Wm. H. Nicholls Co., Brooklyn, N. Y., manufacturer of molding machines, has awarded a contract for a plant addition, 100 x 160 feet, of steel construction. The proposed building will be equipped for the manufacture of the company's larger sizes of machines. The company is now buying the following equipment: One 9-foot vertical boring mill, one heavy type floor horizontal boring mill, one 20-foot heavy duty shafting lathe, one had screw machine, one heavy roll type grinder, for grinding pistons up to 42 inches; several small lathes, milling machines and heat treating and hardening furnaces. The company will install three overhead cranes of one, five and ten tons capacity respectively. The plant is to be erected on property adjoining the Richmond Hill Foundry Co., owned and operated by the Wm. H. Nicholls Co.

George Mesta Dies

George Mesta, aged 63, a director and president of the Mesta Machine Co., West Homestead, Pa., died recently in New York after protracted illness. He was born in Bethel township, Allegheny county, Pennsylvania, March 31, 1862, and was educated in the public schools there, also in Bethel academy, and was graduated from the Western University of Pennsylvania engineering school in 1885. In 1886, Mr. Mesta became affiliated with Totten & Co., Pittsburgh, as engineer, designing engines and rolling mill machinery. In 1887 he organized the Leechburg Foundry & Machine Co., and became vice president and general manager of the company. In 1889 he was elected its president.

In 1898, Mr. Mesta organized the Mesta Machine Co., became president of the same and started the building of the present plant at West Homestead. In the latter part of 1898, the Mesta company purchased the plants of the Leechburg Foundry & Machine Co. and the Robinson-Rea Mfg. Co., Pittsburgh. He was a member of

GEORGE MESTA

the American Iron and Steel institute, the American Society of Mechanical Engineers, the American Institute of Mining and Metallurgical Engineers, the National Association of Manufacturers, and the Engineers Society of Western Pennsylvania. He was a member also of many social organizations in Pittsburgh, New York and Washington.

Plan Annual Meeting

The annual banquet and election of officers of the Detroit Foundrymen's association will be held in the club rooms of the Detroit Union League, 35 West Grand River avenue, May 21, at 2:30 p. m. R. M. Scott is secretary.

J. F. Poland has been appointed manager of the Chicago office, 208 S. La Salle St., of the Brown Hoisting Machinery Co., Cleveland.

Points Danger to Gray Iron Industry

Drastic steps must be taken if gray iron foundries are to check and regain their steadily slipping position in industry, declared Dr. Moldenke before the Newark Foundrymen's association at its meeting, May 5. The encroachment into the gray iron field by manufacturers of other products has been rapid, and only by concerted action in the formation of associations for the exchange of information, the appointment of research bodies, and the development, as an industry, of extensive advertising campaigns can they hope to stem the tide. He also stressed the importance of gray iron founders, as individuals, paying closer attention to the details of their own operations. Greater care should mark the buying of raw materials.

All officers were re-elected for the ensuing year as follows: President, J. L. Carter, Barlow Foundry, Inc., Newark; vice president, William Goldsmith, C. A. Goldsmith Co., Newark; treasurer, J. A. Williamson, Isbell-Porter Co., Newark; and secretary, W. H. Mantz, Atlas Foundry Co., Irvington, N. J.

Sorrow was expressed over the death of A. O. Backert, past president of the American Foundrymen's association and late president of the Penton Publishing Co., Cleveland. The members arose in silent tribute to his memory.

Install Equipment

S. Obermayer Co. recently has let contracts for the installation of equipment at its Cincinnati plant and to extend its activities in the manufacture of refractories and plastic firebrick material. The new manufacturing unit will cost approximately $25,000 and will be in operation within a few months.

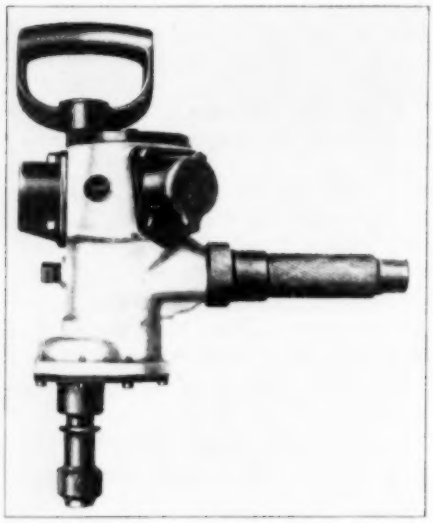
Obituary

Charles G. Ette, secretary-manager of the St. Louis Malleable Castings Co., St. Louis, died recently as a result of a gunshot wound. Mr. Ette was 69 years old.

John J. Redmond, vice president of the Fulton Iron Works Co., St. Louis, in charge of sales and a member of the board of directors, died recently at Raclife, Brazil. Mr. Redmond was 29 years old. He had been in South America since September in the interest of the company.

Builds Boring Machine

A new, lightweight reversible pneumatic woodboring machine has been introduced by the Ingersoll-Rand Co., New York, which is suitable for boring holes up to 1-inch in diameter. The construction of this machine is similar to that of the other three cylinder drills manufactured by this company. The features claimed for the machine are a special three cylinder motor, aluminum case, steel bushings cast in place in all the bearing holes and throttle hole, renewable crankpin sleeve and cast-iron cylinders which are renewable and interchangeable. The average working speed is 705 revolutions per minute, the total weight being 15 pounds.



THE CYLINDERS ARE INTERCHANGEABLE

Recommends Medal for Research Work

The executive committee of the American Society for Testing Materials has recommended to the society the annual presentation of a medal to stimulate research in materials and keep before the members the important function of promoting knowledge of engineering materials.

It is proposed that the medal shall take the name of the first president of the society, Charles B. Dudley, 1842-1909. Mr. Dudley, whose most distinguished service was as chemist of the Pennsylvania railroad, which position he held from 1875 till his death, served as president of the A. S. T. M. from 1902 to 1909, and his leadership has had a profound influence upon the development of the society.

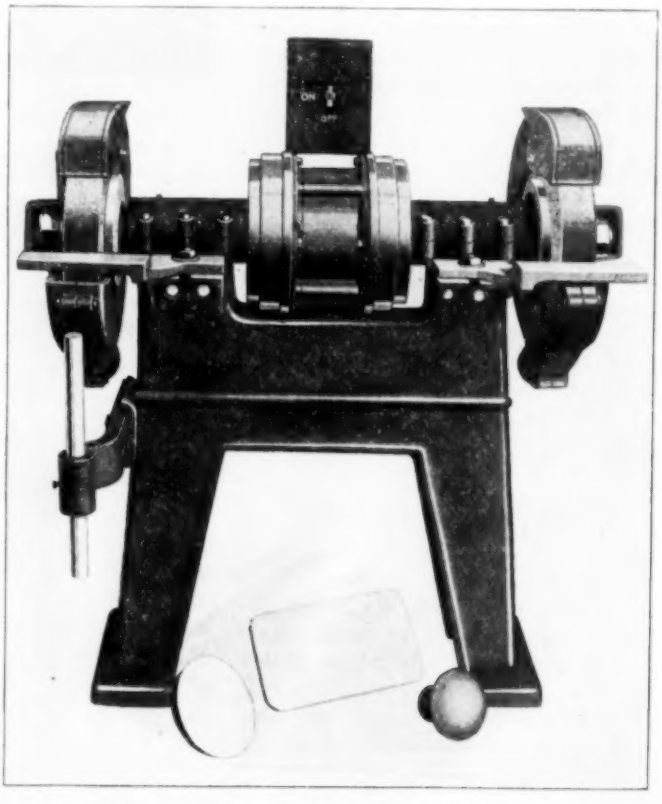
It is recommended that this medal shall be awarded to the author or authors of a paper of outstanding merit presented before the society constituting an original contribution on research in materials, with the understanding that if no paper in any given year seems to merit this distinction, the award will not be made. The executive committee will appoint annually a committee on award of the medal to consist of three members.

To Keep Reserve Stocks

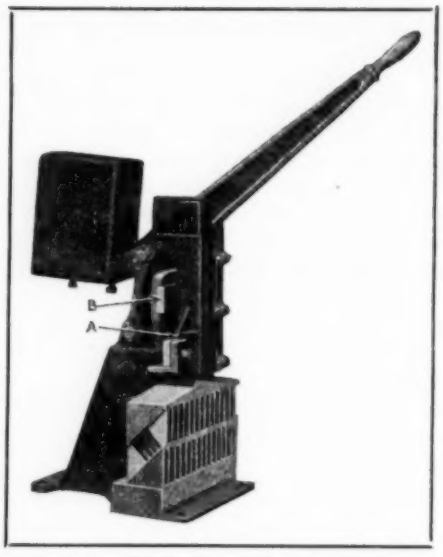
The Link-Belt Co., Chicago has placed in operation a new plan by which complete lines of silent chain drives are now available for immediate delivery by distributors located in the principal cities. Back of these distributors will be the large stocks in reserve in the warehouses of the company's factories at Chicago, Indianapolis and Philadelphia.

Grinder Designed for Foundry Service

Clizbe Bros. Mfg. Co., Plymouth, Ind., has made a number of improvements on its grinder built especially for foundry use. The machine, which is shown in the accompanying illustration, is fitted with either a 3¾ or a 5¾ horsepower motor for wheels 3 x 16 or 3 x 18 inches respectively. Alternating current three-phase, 60 cycle motors are standard equipment, but other types of motors will be furnished on special orders. The equipment also includes guards for either size wheels. Double bearing, self-aligning hanger boxes, mounted on dust-proof housings are used. The diameter of the flanges is equal to one half the maximum wheel size recommended. Three sets of special rests regularly are furnished in addition to regular flat work rests. Forced lubrication is used throughout the foundry grinder. The height of the center of the spindle is 34¼ inches and the distance between wheels is 32½ inches. The construction of the base and the distance between wheels permits two workmen to use the machine without interfering with each other.



TWO MEN MAY WORK AT THIS MACHINE AT THE SAME TIME



THE DIES WORK ON THE PRINCIPLE OF THE CONTRACTING SQUARE

Straightens Wire

A machine for straightening wire and nails up to ¼-inch in diameter has been developed by C. E. McArthur & Co., Chicago. The dies, which are heat treated and hardened, are 9⅝ inches long and built on the principle of a contracting square. The crooked wire is fed into the opening of the

dies and the handle brought down squeezing the wire straight. The machine also is equipped with a shear for cutting wire. When cutting the wire, it is inserted at *A* shown in the accompanying illustration, the part indicated at *B* doing the cutting. The cutter is so designed that by giving it a quarter of a turn, a new edge is brought into use, there being eight cutting edges in all. Skilled labor is not required to operate the machine.

British Foundrymen To Meet in Glasgow

The annual convention of the Institute of British Foundrymen is to be held in Glasgow, Scotland, on June 10, 11 and 12, 1925. John Cameron, of Messrs. Cameron & Roberton, Ltd., will be president-elect. The Right Hon. Lord Weir, of Eastwood, will be president of the reception committee.

The American exchange paper which will be presented at the sessions is entitled, The Present Status of Our Knowledge of Sand Testing, by Dr. H. Ries, professor of geology at Cornell university. The French exchange paper, Heat Resisting Cast Iron, will be presented by Andre Levi, chemical engineer. Other papers which will be read and discussed at the sessions include: Low Temperature Heat Treatment of Special Cast Irons, by J. W. Donaldson; Malleable Iron, by F. H. Hurren; The Practical Applications of Metallography in Bronze Founding, by F. W. Rowe; Aluminum Alloy Castings—Preparation, Treatment, Properties, by F. S. Archbutt; A Note Upon the Practice and Purpose of Perlite Iron, by H. J. Young.

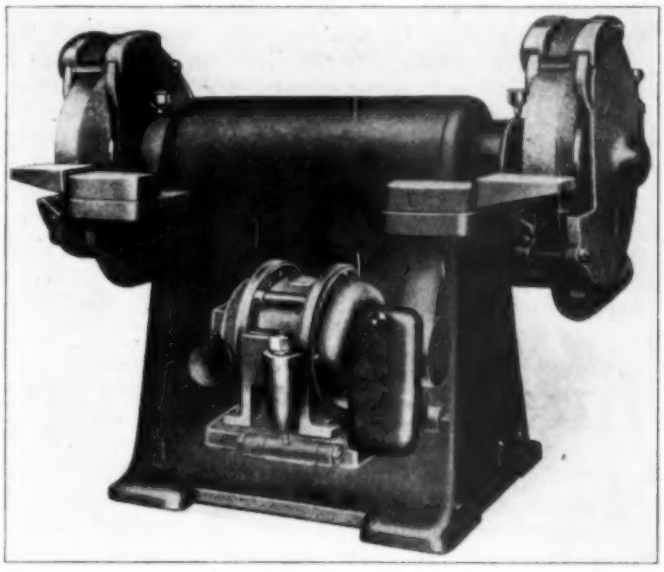
Control Torch Easily

The Bastian-Blessing Co., Chicago, has introduced a welding torch which has a catch operated by the thumb of the operator and which may be engaged or released quickly. When this catch is released, both gases are shut off simultaneously. When the catch is engaged both gases flow freely and it is only necessary to snap the spark lighter to have a flame burning. It is claimed that much time may be saved by this device. The torch is shown in the accompanying illustration.

THE CATCH IS OPERATED QUICKLY

Motor Is Enclosed in Grinder Base

The Norton Co., Worcester, Mass., has designed a new grinding wheel stand which has the motor enclosed in the base. The motor is mounted on the base of the machine on a pivoted platform which permits an adjustment for belt tension. In this location the motor is protected from dust. The wheel spindle runs on roller bearings with an adjustment for wear. Two pulleys, mounted on the spindle, provide the proper surface speed for wheels of various sizes. The combination protection and dust hoods are designed strong enough to hold fragments of broken wheel, and have a hinged cover to facilitate wheel changes. The machine is built in 16, 20 and 24-inch sizes.



THE MOTOR IS PIVOTED TO THE FRAME PROVIDING FOR BELT ADJUSTMENT

To Aid Research

Four research fellowships in metallurgy are offered for next year at the Carnegie Institute of Technology and the Pittsburgh experiment station of the United States bureau of mines. The research program for next year will be a continuation of the plan for research in metallurgical problems effected a year ago between Carnegie Tech, the bureau of mines, and advisory board composed of men prominent and active in the metallurgical industries of the Pittsburgh district.

The work of the research fellows will cover a period of ten months beginning August 17, 1925. Each fellowship is valued at $750, in addition to a remission of the usual tuition fee. Applicants, must have a thorough training in chemistry, physics, and the fundamental engineering subjects.

The holders of the fellowships will take an active part in the metallurgical research work at the bureau of mines. The problems will be selected by a committee of representatives from the advisory board, the bureau of mines, and the institute.

A Correction

In an article published in the April 15, 1925 issue of THE FOUNDRY entitled "Peep Into Cupola When Melting Steel", by J. Grennan of the department of engineering shops, university of Michigan, through a mechanical error the group of micrographs on page 315 was inverted. As a result Fig. 8 should read Fig. 4, Fig. 7 should read Fig. 5. In other words if the reprints collectively are revolved 180 degrees around a point at the center of Fig. 6, they will be in proper position to fit the printed matter.

Appoints Sales Engineers

The Industrial Works, Bay City, Mich. has appointed four additional district sales engineers, Douglas J. Calder, Conway J. Neacy and Monroe J. Frankel. They will be located at the Chicago offices of the company 1051 McCormick Bldg. Chester F. Delbridge will be located at the St. Louis district office, Railway Exchange Bldg., St. Louis.

Sales Improvement Steady

Since First of Year Increases Have Been Shown in Volume of Business—
Many Find Difficulty in Maintaining Sales Program—
March Exports Increase

PESSIMISTIC talk coming from various distributing centers for foundry equipment does not seem justified at this time in view of the general condition in the market. In spite of the resistance to sales efforts that has been experienced for several months, the volume of sales of equipment generally has shown a gain since the first of the year. Business may be slightly under that realized in what may be considered a normal year, and yet several plants are having the best year in their history. Many manufacturers, influenced by the talk of a boom year prevalent around the first of the year, placed the goal for volume of sales at such a high point that they are experiencing some difficulty in maintaining the program. The fact that little new construction is developing in the automobile field also is having its effect on the market. Inquiries are good and many prospects for early closing are reported.

Exports of foundry and molding equipment increased slightly in March, the value of exports being $49,951 as compared with $40,096 in February. A large increase was shown over the corresponding month in 1924 when the value of exports was $36,997. The exports for nine months ended March was $440,461 as compared with $236,469 during corresponding period last year.

Interest in Equipment Continues

THE spotty condition previously reported in the foundry equipment market in the Cleveland territory continues to exist, and while the manufacturers of a few lines of equipment are securing sufficient business to keep their plants running at a fairly high percentage of capacity, others are not securing a satisfactory total. Sales are confined chiefly to plants making a specialty, and where the entire output is contracted ahead. The new equipment being purchased is being applied chiefly to replacements, little developing in the way of new plants. In most cases, total sales for April showed a slight gain over March. Inquiries continue good, and numerous promising propositions are pending. Fairbanks-Morse & Co., Three Rivers, Mich., have ordered a large type core and mold oven and four 25-ton oven cars from the F. A. Coleman Co., Cleveland. Vibrator and shakeout equipment has been purchased by the Griffin Wheel Co., Kansas City, Kan., Whitehead & Kales, River Rouge, Mich., Westinghouse Air Brake Co., Wilmerding, Pa., the American Radiator Co., Buffalo, the Cleveland Co-Operative Stove Co., Cleveland, the Pullman Car & Mfg. Co., Pullman, Ill., and the Dayton Steel Foundry Co., Dayton, O., from the Stoney Foundry Engineering & Equipment Co., Cleveland. The Weil-McClain Co., Michigan City, Ind., has purchased two core ovens with furnaces attached and the Madison Foundry Co., Cleveland, has ordered an oven and furnace from the Mayor Fuel Saving Furnace Co., Cleveland. Tumbling mill equipment has been purchased by the Packard Motor Car Co., Detroit, the Hudson Motor Car Co., Detroit, the Westinghouse Electric & Mfg. Co., Trafford City, Pa., the Dunham Co., Berea, O., and the Boyton Furnace Co., Jersey City, N. J., from the W. W. Sly Mfg. Co., Cleveland. This manufacturer also has sold sand-blast equipment to the General Electric Co., Everett, Mass., the Holmes Foundry Co., Port Huron, Mich., and the Ypsilanti Foundry Co., Ypsilanti, Mich.

Pittsburgh Buyers Hesitate

WHILE there has been a steady but small improvement in foundry equipment buying since the first of the year in the greater Pittsburgh territory, during the past two or three weeks sellers have encountered a general hesitancy in placing orders. Occasionally, orders for one or two pieces of machinery stand out from the general run of small supply business. The Allegheny Foundry & Machine Co., Glassmere, Pa., for instance, bought a large sand separator from the J. S. McCormick Co., Pittsburgh, a duplicate of the one sold recently to the Pittsburgh Gray Iron Foundry Co., Pittsburgh. This dealer, with others, reports a fairly steady movement of such small equipment, such as riddles, shovels, vibrators, hand ladles, and kindred equipment, and crucible sellers likewise have been active. The American Bridge Co., Ambridge, Pa., recently placed a large order for steel flasks. A large local foundry is about to purchase a core oven, together with molding machines and other equipment. The United Engineering & Foundry Co., Pittsburgh, has decided to build its own core oven, but a foundry at Mt. Pleasant, Pa., is in the market for core oven equipment. While the Allegheny Steel Co., Pittsburgh, is extending its foundry space, This is merely to obtain more room and it will not purchase more foundry equipment at present although may buy a core oven later. Pending inquiries for molding machines are numerous and some attractive orders are scheduled to be placed within the next two weeks, large users like the General Electric Co. and some of the radiator manufacturers contemplating early purchases of two or more machines. Recent important orders coming to the Herman Pneumatic Machine Co., Zelienople, Pa., include one large rollover machine for the Monroe Steel Castings Co., Monroe, Mich., and two for the International Heater Co., Utica, N. Y. The Covel Mfg. Co., Benton Harbor, Mich., ordered two 1-ton helical worm-geared ladles from the Whiting Corp., Harvey, Ill., which also recently sold one of its cupolas complete with accessories to the Athens Stove Co., Athens, Tenn., two standard tumblers to the Iowa Malleable Iron Co., Fairfield, Ia., and several ladles to the American Manganese Steel Co., Denver, Colo. It also sold two ladles to Campbell, Wyant & Cannon, Muskegon, Mich. The DuBois Iron Works, DuBois, Pa., has purchased sand-blast equipment from

the Pangborn Corp., Hagerstown, Md. The Vulcan Mold & Iron Corp., Latrobe, Pa., recently entered the market for a locomotive crane but may rent or purchase a second hand crane for the installation of its cupola. The Atlas Sanitary Mfg. Co., Zelienople, Pa., is about to purchase cleaning and enameling room equipment. The new Westcott Pump & Valve Co., East St. Louis, Ill., bought a 3-ton, 3-motor crane with 29-foot span from the Whiting Corp.

Eastern Dullness Continues

THE dullness that has prevailed for some time in the eastern foundry equipment market continues. Inquiry picked up a trifle for a week or so, then slowed up again. There appears to have been no change in the rate of buying. Considering the season of the year, business has been a disappointment to most sellers. Dust arrester equipment has been purchased by R. Hoe & Co., New York, from the Pangborn Corp., Hagerstown, Md. Among the more active buyers is the United States Cast Iron Pipe & Foundry Co., Burlington, N. J. This interest has closed on eight 5-ton electric cranes to an eastern builder. Of this list, five were of 50-foot span, two of 45-foot span and one of 15-foot span. The Florence Pipe, Foundry & Machine Co., Florence, N. J., inquiring for five electric overhead cranes and other equipment, has taken no action. This company is planning a new addition. The Fairmont Foundry, Philadelphia, contemplates a new addition and is figuring tentatively on miscellaneous equipment. All in all, there is little in the way of new construction, with such buying as there is largely for replacement purposes. The dullness of the market may be attributed to low foundry operations which in the New York metropolitan district continue to hover around 40 to 50 per cent, with the truer average possibly nearer the inside figure, while some of the speciality shops, active throughout the winter and early spring, have curtailed operations considerably. Owing to sharp competition, prices are none too settled. This is particularly noticeable in conveying equipment. J. W. Paxson Co., Philadelphia, has orders for two cupolas, 42 and 63 inches respectively, along with blower equipment, for the Du Pont Engineering Co., Wilmington, Del.; a 91-inch cupola for the Draper Corp., Hopedale, Mass.; and some tumbling barrel equipment for the Du Bois Iron Works, Du Bois, Pa.

Chicago Inquiry Fair

INQUIRY for foundry equipment in the Chicago district continues only fair, according to Chicago district makers. Prospects appear brightest among those foundries engaged upon automobile work, but with inquiry for more than 20,000 freight cars pending, other foundries may come into the market. The National Engineering Co., Chicago, has placed its sand mixers in the foundries of Crane Co., Chicago; Berryhill Malleable Iron Co., Evansville, Ind., and the Jamestown Malleable Products Co., Jamestown, N. Y. Sand-blast equipment has been ordered by the Muncie Malleable Foundry Co., Muncie, Ind., and Fuller & Sons Mfg. Co., Kalamazoo, Mich., dust arrester equipment by the Rock Island Stove Co., Rock Island, Ill., and sand-blast and dust arrester equipment by the Buick Motor Co., Flint, Mich., from the Pangborn Corp., Hagerstown, Md.

New England Orders Scarce

WHILE inquiry appears decidedly encouraging in the New England market, recent foundry equipment sales have been scarce. Scattered orders among Massachusetts foundries total eight or ten molding machines, and a Maine foundry bought a 5-ton traveling crane. A Bridgeport, Conn., foundryman is in the market for 10 or 12 molding machines. The Nutmeg Crucible Steel Co., Stoney Creek, Conn., has secured dust arrester equipment from the Pangborn Corp., Hagerstown, Md. A Worcester, Mass., plant is receiving quotations for an annealing oven. Foundry activity within the district has shown gradual improvement since the first of the month.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

J. D. Ryan Foundry Co., Encorse, Mich., has been damaged by fire and will be rebuilt.

Racine Malleable & Wrought Iron Co., Racine, Wis., will rebuild its burned foundry, 50 x 300 feet.

Lakeside Malleable Casting Co., Racine, Wis., will rebuild a portion of its plant recently destroyed by fire.

General Foundry Co., Tacoma, Wash., has changed its name to the General Foundries & Mfg. Co.

Odin Stove Mfg. Co., Erie, Pa., has let a contract for an addition to its plant. C. F. Hoffstetter is general manager.

Atlanta Plow Co., Atlanta, Ga., may establish a large plant at Dallas, Tex., for the manufacture of plows and other implements.

Gerlinger Steel Castings Co., Mitchell street and Sixtieth avenue, West Allis, Wis., is in the market for molding machines.

Plans are being formulated by state authorities for establishment of an iron foundry at the state penitentiary at Atlanta, Ga.

Fay Foundry Co., Broad street, Benton Harbor, Mich., is building an office and pattern storage building.

Allen Mfg. Co., Chattanooga, Tenn., has started operations in its new foundry addition which has doubled its capacity.

Martin Metals Foundries Co., Inc., Newark, N. J., expects to build a new foundry for various aluminum alloys.

Ridge Cast Products Co., Mineral Ridge, O., has awarded a contract for a 1-story foundry addition.

Ralston Steel Car Co., Columbus, O., will ask for bids soon on an addition to be completed this summer.

Angels Foundry, Angels, Calif., a subsidiary of the Hicks Iron Works, San Francisco, will be enlarged to increase output. E. H. Oliphant is vice president.

A portion of the foundry of the S. M. Howes Co., Boston, recently was destroyed by fire. Plans for rebuilding are being considered.

Blackhawk Foundry & Machine Co., Davenport, Iowa, will erect a foundry addition doubling its capacity of gray iron and aluminum castings.

Superior Bronze & Aluminum Co., Warren, O., has been incorporated with $20,000 by Arthur J. Gilmoure, Frank Wande and Frank W. Boyle.

Charles Hesterberg, College Corners, O., will establish a foundry and machine shop for production of brass fittings. Equipment will be needed.

United Engineering & Foundry Co., Pittsburgh, will build a 1-story addition at its Kneeland Frank Machine Co. division, Fifty-fourth street.

Atlantic Coast Line, Waycross, Ga., J. E. Willoughby, chief engineer, Wilmington, N. C., will enlarge its wheel foundry and other departments and install a pumping station.

Atlas Sanitary Mfg. Co., Zelienople, Pa., will build several additions, including foundry, cleaning house, enamel shop and shipping room.

Lloyd Metal Co., 1320 Carr street, Houston, Tex., will build a foundry 50 x 100 feet. A. Delisle, 1908 Drew avenue, is architect.

Unique Brass Mfg. Co., 123 Military avenue,

Detroit, will build an addition, the general contract being let to Everett Winters Co., Book building.

American Manganese Steel Co., has started operations at its new Los Angeles plant. It has capacity for 100 tons per day, operating entirely on scrap. The first heat was made April 16.

Progress in construction of the new plant of the Berryhill Malleable Iron Co., Evansville, Ind., indicates production will be started in June. It is of fireproof construction. J. H. Berryhill is president of the company.

P. A. Dubus & Son, Inc., New Orleans, has been incorporated with $75,000 capital to operate a foundry and machine shop for repairing pumping machinery. J. C. Allen, 634 Louisa street, is secretary.

Kunst Art Foundries, New York, has been incorporated with $100,000 capital by A. Kunst, A. Kiss and J. Bayko. Buchdahl, Males & Lampel, 276 Fifth avenue, are attorneys.

Schmandt Foundry Co., Detroit, has been incorporated with $25,000 capital to conduct a foundry and machine shop by Frank Leckner, Joseph A. Barnett and John B. Schmandt, 3074 Congar avenue.

Quality Mfg. Co., Evansville, Ind., successor to the Evansville Steering Wheel Mfg. Co., is building a new foundry and will add other automobile accessories to its line of steering wheels.

Scovill Mfg. Co., Waterbury, Conn., has bought control of the Morency VanBuren Mfg. Co., Sturgis, Mich., manufacturer of tank fittings and shower valves. The plant at Sturgis will be enlarged considerably.

Pacific Gas & Electric Co., Pacific Gas & Electric building, San Francisco, has awarded a contract for the construction of four buildings at Emeryville, Calif., including a foundry for making gray iron and brass castings. The foundry will be 60 x 125 feet.

Wheeling Bronze Casting Co., Wheeling, W. Va., has merged with the B. & M. Rolling Mill Co., that city, under the name of the former company. Operations are carried on at Thirty-sixth and McColloch streets, Wheeling. The capital stock has been increased.

The A. K. Pattern Works, West Allis, Wis., capital stock $5000, has been incorporated to manufacture wood and metal patterns and similar goods. George Smith, E. D. Albrecht, and A. O. Kopperud, brass foundry men, are the incorporators.

XL Cast Iron Smoke Pipe Co., 2127 Lafayette street, Waterloo, Iowa, has been incorporated with $25,000 capital to manufacture cast iron smoke pipe, hog troughs, cistern covers and similar castings, and general foundry jobbing. A. C. Anderson is manager.

Grand Haven Brass Foundry, Grand Haven, Mich., is negotiating with the Kelly Valve Co., Muskegon, Mich., to take over its entire production of valves. An addition will be built and new equipment installed on completion of the arrangement.

Rempis & Gallmeyer Foundry Co., Grand Rapids, Mich., manufacturer of iron, brass and aluminum castings, has completed a new brass foundry. Semisteel castings also will be added to the line of products of the company.

Sharples Centrifugal Co., West Chester, Pa., is being organized to operate plants of the Sharples Separator Co. and will increase facilities for production of oil and milk separators and parts. The works at Philadelphia will be removed later to West Chester.

The Riverside Iron Works Co., 410 Riverside boulevard, Calgary, Alta., will build a new foundry here to cost $20,000. Equipment, machinery and tools will be purchased. Foster & Ritchie, 2116 Sixteenth street, West, have the general contract for the erection of the building.

New Trade Publications

LIFT TRUCKS—The Plimpton Lift Truck Corp., Stamford, Conn., has issued a booklet describing and illustrating its lift truck.

WIRE STRAIGHTENER—A machine for straightening and shearing wire is described and illustrated in a folder issued by C. E. McArthur & Co., Chicago.

REVOLVING SCREENS—The Allis-Chalmers Mfg. Co., Milwaukee, Wis., has issued a folder describing an iron frame revolving screen for foundries.

PULLEYS—A leaflet calling attention to the variety of pulleys it produces has been mailed to users by the W. A. Jones Foundry & Machine Co., Chicago.

FIRE BRICK—Details of compounding and baking refractory brick are related in a leaflet by the Ashland Fire Brick Co., Ashland, Ky.

FIRE PUMPS—Turbine driven underwriters fire pumps are featured in one of its standard bulletins by the Standard Turbine Corp., Scio, New York.

GRINDERS—Clizbe Bros. Mfg. Co., Plymouth, Ind., has issued a pamphlet describing its grinding machine for foundry use. The features of the machine and the rests are described and illustrated.

CULVERT PIPE—Spiral corrugated cast iron culvert pipe is thoroughly described and well illustrated in two pamphlets recently issued by the American Castings Co., Birmingham, Ala.

ELECTRIC TOOLS—The construction of its electrical tools is thoroughly described in a folder issued by the Independent Pneumatic Tool Co., Chicago. The various parts are well illustrated.

SAW—A high production swing saw is described in a booklet published by the Oliver Machinery Co., Grand Rapids, Mich. This saw finds application in the pattern shop. A new style swing saw table also is described.

PERMANENT MOLD CASTINGS—A process of making aluminum castings up to 17 pounds weight in permanent molds, with claims of excellence in quality of metal is described in a circular by the Permold Co., Cleveland.

SPEED REDUCTION UNITS—Boston Gear Works, Norfolk Downs, Quincy, Mass., has issued a booklet describing a new series of standardized speed reduction units, with full engineering data.

BEARINGS MATERIAL—A slow-wearing material produced by combination of several metals has been produced by J. E. Loudon & Co., Boston, and is described in a current booklet.

DUST FILTERS—Removing dust from air by a filter, the construction of the device and how it operates, form the subject matter of a circular by the Dust Recovering & Conveying Corp., Cleveland.

TRAILERS—Two types of trailers are described and illustrated in two folders which recently have been published by the Mercury Mfg. Co., Chicago. The various features and the specifications of the trailers are given.

PORTABLE ELECTRIC MACHINERY—The R. G. Haskins Co., Chicago, has published a catalog of exible shaft equipment, portable tools and labor saving devices. The catalog is well illustrated and the specifications of the tools are given.

SAND THROWING MACHINES — The Beardsley & Piper Co., Chicago, has issued an 8-page folder describing various types of sand throwing machines. Reproductions of photographs show the machine in operation.

PORTABLE ELEVATORS—The Barrett-Cravens Co., Chicago, has issued a catalog presenting its governor controlled, gear enclosed portable elevator, well illustrated to cover the field of its operations. Details of construction and operation are given clearly and fully.

LIFTING MAGNETS—Uses of magnets in the iron and steel industry are discussed and illustrated in a booklet by the Ohio Electric & Controller Co., Cleveland. A wide range of use as lifting and separating agents is presented in the pictorial embellishment.

SNAP FLASKS—Cast aluminum taper snap flasks and steel pouring jackets manufactured by the American Foundry Equipment Co., New York, are described and illustrated in a pamphlet uniform with previous issues of this manufacturer.

RIVETLESS CONEYOR CHAIN—Assembly and disassembly of rivetless chain for use in conveyors and elevators is described in detail in a book by the Link-Belt Co., Chicago. Light weight and strength are put forward as factors in its usefulness.

GRINDING WHEEL STANDS—A grinding wheel stand having the motor mounted on a platform located on the inside of the stand is described in a folder which has been issued by the Norton Co., Worcester, Mass. The characteristic features and specifications of the machine are given.

PNEUMATIC GRINDERS—The Warner & Swasey Co., Cleveland, has issued a booklet describing a new portable grinder which recently has been placed on the market. Drawings show the construction of the machine and reproductions of photographs show the various types now being made.

GAS VALVES—A motor operated gas valve which automatically controls the flow of gas to the burner when actuated by a pyrometer or thermostat is described in a bulletin by Dickson Industrial Equipment, Chicago. The company also has issued a bulleting describing a thermoelectric pyrometer.

MANGANESE STEEL—A circular by the American Manganese Steel Co., Chicago Heights, Ill., might serve as a tabloid textbook on manganese steel. It contains a list of nearly all the uses of this steel so far developed and a catechism on the nature and properties of the material.

CUPOLA ALLOY—A mixture compounded to the requirements of the user is offered by the Chicago Crucible Co., Chicago, for use in the cupola to give the desired alloy in the ladle. The value of such a vehicle to carry the alloying elements into the metal is presented in a pamphlet by that company.

REFRACTORIES—A treatise on the building of monolithic furnace linings is presented in its second edition by the Plibrico Jointless Firebrick Co., Chicago. Causes of furnace troubles, a solution of the trouble and tests of the material are presented. Temperature charts with various materials indicate differences in radiation. Illustrations show various steps in applying the material and views are given of various jobs in process and completed.

How To Put On a Zippy Finish— CUT CASTINGS PRICES

WILLIAM GILBERT, who runs a foundry in Ada, Okla., finds time to tour during the summer. He has been impressed during his travels by the many buildings, formerly foundries that now are given over to other uses. As he puts it:

"Hush little foundry, don't you cry,
You'll be a gay-rage, bye and bye."

The pathetic part of this little ballad is its truth. He comments on the fact that specialty foundries will continue to operate, and that those that consider production methods closely and watch costs, will grow and prosper. He observes that if all foundrymen would stop price cutting, all would be better off and makes the pointed inquiry, "Is there any real reason why a foundry should be run just for fun?"

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MANY may think that I am bearing down too strong on this price cutting evil, but as the colored preacher said about the Devil, "he just cahn't be talked 'bout unprominently 'nuf." For the foundry that through ignorance or mistake quotes too low a price, some excuse may exist, although the only place where one may expect to get flowers for making mistakes is in a powder factory. But the foundryman who knows his costs and through a desire to carry his overhead or to keep some other fellow from getting the job, cuts his price under costs, surely is singing that garage lullaby to his business future.

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ONE strong factor in this price cutting tendency is the readiness with which many foundrymen accept the word of the buyer that some competitor has quoted a much lower price. A purchaser cannot be blamed for buying his goods as cheaply as possible and many are tempted to try the credulity of those who attempt to sell them. I heard of a case in which a foundry manager suspected an automobile firm of such practice. Prices were asked on a number of special castings, so after an interval, this foundryman dropped in and asked the buyer how he stood on the job. The purchaser, fumbled some papers on his desk and announced with the proper shade of friendly regret, "I'm sorry, but you are just a cent and a quarter high, though I haven't let the job yet.". Get that gentle hint to cut the price? "S funny," said the foundryman, "Wonder how you figured that out. I've got my estimate in my pocket. Intended to hand it to you today, but I guess I won't." Only that wasn't all that he said. You can supply the other words he used and the accompanying gestures consisting of the thumb held horizontal, slightly below the level of the eyes and the figures waved gently in the air like a rag.

P. T. Barnum Says!

FORTUNE favors the brave and never helps a man who does not help himself.

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JUST suppose the bid had been submitted and the foundryman had been shaky as to his real costs. Isn't it reasonable to suppose that he would have shaved that cent and a quarter and even a little more? No contractor preparing an estimate on a public improvement involving millions would be willing to take another person's statement that his bid was too high. He would *know* that his figure was correct to the best of his knowledge of costs, labor charges and profit. The chain stores, notably those that are known familiarly as the *dime* stores, are said never to sell any article without making at least the narrow margin of profit set to cover all commodities handled. Why, then, can any foundry expect to stay in business when costs are unknown or disregarded and profits are lopped off on the prejudiced word of a buyer? Art Tuscany of the Ohio foundrymen said sometime ago, "Count that day lost, who's low descending sun, finds prices shot to hell, and business done for fun." Oklahoma and Ohio agree.

Phineas, Jr.